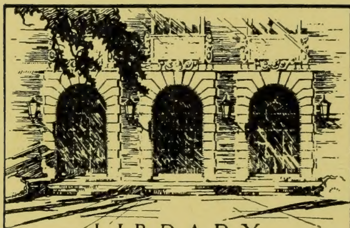

REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

1909-1910

SOCORRO, N. M.

MAIN BUILDING.

ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1909-10

WITH ANNOUNCEMENTS FOR 1910-11

SANTA FE, N. M.:
THE NEW MEXICAN PRINTING COMPANY.
1909.

CALENDAR.

1910-1911.

First Semester:

September 12, Monday—Registration of students.
November 24 and 25, Thursday and Friday—Thanksgiving recess.
December 22, Thursday—Christmas vacation begins.
January 4, Wednesday—Work resumed.
January 16-19, Monday to Thursday—Examinations.

Second Semester:

January 20, Friday—Registration of students.
February 22, Wednesday—Washington's birthday.
May 15-18, Monday to Thursday—Examinations.
May 19, Friday—Commencement.

FACULTY.

EMMET ADDIS DRAKE, A. B., A. M., *President of the Faculty, Professor of Languages.*

A. B., Wisconsin University, 1882: A. M., Wisconsin University, 1887; Assistant Engineer, Northern Pacific Railroad Co., 1882-1883; Instructor in Rhetoric and Oratory, Wisconsin University. 1883-1884; Instructor, Missouri School of Mines, 1884-1891; General Manager, Columbia Mining Co., 1891-1897; Professor of Languages, New Mexico School of Mines, 1897—; President of New Mexico School of Mines, 1908—; Editor Socorro Chieftain, 1900—.

REINOLD VERNON SMITH, B. S., *Professor of Mining and Metallurgy.*

B. S., University of Utah, 1895; Superintendent of Schools, Bingham, Utah, 1895-1897; Purchasing Agent, R. G., S. M. and P. Ry., Juarez, Mexico. 1896-1898; with Smith and Lyon, Mining Engineers, Salt Lake City, Utah, 1898-1900; Metallurgist, Dexter-Tuscarora Consolidated Gold Mining Co., Tuscarora, Nevada, 1900-1903; Metallurgist Mercur Consolidated Gold Mining Co., Mercur, Utah, 1903; Metallurgical Engineer, Sevier Consolidated Gold Mining Co., Sevier, Utah, 1903-1904; Instructor in Chemistry and Physics, University of Utah, 1904-1906; Professor of Mining and Metallurgy, New Mexico School of Mines, 1906—.

LON CAIN WALKER, Ph. B., A. B., A. M., *Professor of Mathematics.*

Ph. B., Ohio University, 1893: Scholar in Mathematics, Nebraska University, 1893-1896; A. M., Nebraska University, 1896; A. B., Leland Stanford Junior University, 1901; A. M., Leland Stanford Junior University, 1902; Professor of Mathematics, Colorado School of Mines, 1903-1904; Graduate Student, University of California, 1905-1906; County Examiner and Principal of New Madison, Ohio, Schools, 1889-1892; Teacher, Lincoln, Nebraska, High School, 1895-1896; Teacher of Mathematics, Montana State Normal School, 1898-1899: Assistant in Mathematics, Leland Stanford Junior University, 1900-1901; Teacher in Mathematics, Santa Barbara High School, 1904-1905; Teacher in Mathematics and Mechanics, Oakland Polytechnic College of Engineering, 1905-1907; Computer for Berkeley, California, Real Estate Syndicate, 1906-1908; Professor of Mathematics, New Nexico School of Mines, 1908—.

GEORGE IRVING KEMMERER, A. B., A. M., Ph. D., *Professor of Chemistry.*

A. B., University of Wisconsin, 1904; Graduate Student, University of Wisconsin, 1904-1906; A. M., University of Wisconsin, 1906; Graduate Scholar in Chemistry, University of Pennsylvania, 1906-1908; Ph. D., University of Pennsylvania, 1908; Chemist with Minnesota Iron Co., Summer, 1903; Assistant in Chemistry, University of Wisconsin, 1904-1906; Chemist and Photographer with the Wisconsin Geological and Natural History Survey, Summers of 1907 and 1908; Instructor in Chemistry, Temple University, 1907-1908; Professor of Chemistry, New Mexico School of Mines, 1908—.

FREDERICK PARNELL PAUL, Ph. D., Assoc. B. S. M., *Professor of Geology and Mineralogy.*

Associate, Ballarat School of Mines, 1898; Graduate Student, Freiberg Mining Academy, 1899-1900; Graduate Student, Leipzig University, 1900-1901; Science Director, Sale School of Mines, Australia, 1902-1904; Graduate Student, Heidelberg University, 1906; Ph. D., University of Heidelberg, 1906; Superintendent, Gulf Mountain Tin Mining Co., 1906-1909; Professor of Geology and Mineralogy, New Mexico School of Mines, 1909—.

BYRON KEMP COGHLAN, B. S., *Professor of Civil Engineering.*

B. S., University of Illinois, 1908; Indiana, Illinois and Iowa R. R., 1899-1904; Chicago and Eastern Illinois Ry., 1905; Chicago and Northwestern Ry., 1906; Commonwealth Electric Co. of Chicago, 1907; Superintendent of Manual Training, High and Common Schools, Pontiac, Ill., 1908-1909; Chicago and Northwestern Ry., 1909; Professor of Civil Engineering, New Mexico School of Mines, 1909—.

ROBERT INGERSOLL KIRCHMAN, E. M., *Instructor in Physics and Civil Engineering.*

E. M., Colorado School of Mines, 1909; Instructor in Physics and Civil Engineering, New Mexico School of Mines, 1909—.

CARL CLYDE SMITH, Ph. B., *Principal of the Academy.*

Ph. B., Ohio State University, 1890; Superintendent of Schools, Marietta Township, Marietta, Ohio, 1891-1900; Instructor in Science, High School, Fort Morgan, Colo., 1900-1902; Superintendent of Schools, Berthoud, Colo., 1902-1907: Instructor, Huerfano Co. High School, Walsenburg, Colo., 1907-1908; Principal of Academy, New Mexico School of Mines, 1909—.

ANNE W. FITCH, *Registrar.*

NEW MEXICO SCHOOL OF MINES.

HISTORICAL SKETCH.

The New Mexico School of Mines was founded by act of the Legislature of 1889. The act provided for the support of the School by an annual tax of one-fifth of a mill on all taxable property.

Under an act of the Legislature, approved February 28, 1891, a board of trustees was appointed. Organization was effected and immediate steps were taken towards the erection of necessary buildings. In this same year a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892 a circular of information regarding the New Mexico School of Mines at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land fifty thousand acres for its support and maintenance. From this source of revenue the School has already received more than $17,000.

In 1899 the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901 the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grant of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903 the Thirty-fifth General Assembly raised the millage to forty-five hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

Since 1903 the appropriation for the support and maintenance of the School of Mines has been increased at each session of the General Assembly. At the last session the appropriation was raised to $19,000 a year.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said school require it.

The Board of Trustees shall require such compensation for all

assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico School of Mines is located at Socorro, the county seat of Socorro county, on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the valley of the Rio Grande at the foot of the Socorro range of mountains at an elevation of 4,600 feet above the level of the sea. The surrounding scenery is diversified by plains, valleys, mesas, hills, and mountains. The climate of the locality is pre-eminently pleasant and healthful, and has long attracted health-seekers who would escape the rigors of less favored localities. The air is exceedingly dry and the temperature is mild and equable. Socorro's public water supply comes from warm springs that issue from Socorro mountain three miles away. The water is famed for its purity and has always been an attraction to visitors and residents.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illlustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Deming, Fierro, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-

dressing, concentrating, smelting, lixiviation, cyaniding, and other metallurgical processes.

A number of mines of various kinds, smelters, irrigating systems, and other engineering works are accessible to the School. Within a few hours' ride by rail are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years they have yielded their wealth to the European and centuries before his advent gave up even greater treasures to the native races.

The history of modern mining schools shows that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of the world.

The School is a territorial institution. It was established primarily to promote the development of the mineral resources of New Mexico and to provide facilities for the young men of the territory to secure a practical education in all departments of mining. Naturally, however, the institution's field of usefulness has steadily grown broader. Not only New Mexico but also other parts of the southwest have felt its influence through its graduates in the development of the mining industries of this great region. Moreover, a considerable number of students from other parts of the country who desired to avail themselves of the peculiar advantages of this region have come to the School of Mines for the training they needed and the number of such young men is constantly increasing.

During the entire period of his training the fact is impressed upon the mind of the student that intelligent mining is a business operation capable of being put on as secure a foundation as any other, that from beginning to end it is akin to all other great business undertakings, that while lucky finds will doubtless continue to be made mining is no longer to be considered a mere lottery appealing to the gambling propensities.

During the past quarter of a century the development of the mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surroundings of the School already described create an invigorating mining atmosphere which is entirely wanting in situations remote from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in those technical institutions of learning where all practical branches are equally represented, singleness of purpose is a leading feature of the New Mexico School of Mines. The conservation of energy growing out of the special method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect under the direct supervision of his instructors various plants and works and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the territory has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made under government auspices to investigate closely the geological structure of New Mexico mountains such as has been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican

mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

Much of the advanced professional work of the School is of an original nature to the end that the graduates may be skilled, theoretically and practically, in the very problems which they as professional men will be called upon to solve. This work is carried on by the advanced students under the direction of the professors and involves the collection of notes, sketches, maps, and specimens, and the results of directed observation in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining and in the reduction of the ores of lead, silver, gold, and copper are so numerous that it is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply, and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigations of the ores of iron, manganese, aluminum, cobalt, nickel, tin, and quicksilver, together with the beds of coal, salt, alums, building stones, mineral-paints, cement-rocks, marls, etc., are directly in line with the advanced laboratory work of the School, and every student who undertakes such work is encouraged in every way possible to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the Territory with the concurrence of the Council for a term of four years. The Board of Trustees elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them.

By act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of the territory. The New Mexico School of Mines, therefore, is composed of the College and the Academy.

THE COLLEGE.

The Requirements for Admission.

Candidates for admission to the College must show, either by examination or by the presentation of statements from schools of recognized standing, a satisfactory degree of proficiency in those subjects required in the Academy or in other subjects which are accepted as equivalent to the Academy subjects.

Registration.

No student will be permitted to register for any subject until the pre-requisites are credited to him on the school records. Therefore the student is advised not to delay either in making up any deficiencies which may exist or in obtaining from the School the credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided, that no more than the first two years of the curriculum be thus credited to a student who has not yet received the bachelor's degree, and provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the engineer's degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time of matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the school may rest assured that after entrance his time will be fully occupied.

SPECIAL COURSES.

Students desiring to take special courses without a view to graduation may do so provided that they give evidence of proficiency in the prerequisite subjects and that their taking such courses does not interfere with the regular schedule of classes.

Curricula.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

Mining Engineering.

Metallurgical Engineering.

Mining Geology.

Civil Engineering.

Each curriculum covers four years. Upon the satisfactory completion of either of them, the Bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines who have spent two years in professional work, at least one of which must have been in a position of responsibility, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours' work in the field or in the laboratory. In the following outlined statement of curricula the number of hours per week required in the class-room (C. R.) and in the field or in the laboratory (F. & L.) are given separately. The number of hours required in the field or in the laboratory represents *average* time however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

MINING ENGINEERING.

MINING ENGINEERING.

FIRST YEAR.

Course Numbers.		Courses.	Hours per Week. C. R.	Hours per Week. F. & L.
		First Semester.		
I.	1.	Advanced Algebra	5	
I.	2, 3.	Trigonometry	5	
II.	3.	Kinematics and Machines	2	
III.	1.	General Chemistry	5	6
IV.	1.	Mechanical Drawing and Lettering		8
		Second Semester.		
I.	1.	Advanced Algebra	3	
I.	4, 5.	Analytic Geometry	5	
III.	2.	Quantitative Analysis	1	9
IV.	2.	Mechanical Drawing and Lettering		6
IV.	3.	Descriptive Geometry	3	
IV.	4.	General Surveying	3	4

MINING ENGINEERING.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week. C. R.	Hours per Week. F. & L.
		First Semester.		
I.	6.	Calculus	5	
II.	1.	General Physics	3	6
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
V.	2.	Mineralogy	3	3
		Second Semester.		
I.	6.	Calculus	5	
II.	2.	General Physics	3	3
III.	4.	Wet Assaying	1	9
V.	1.	General Geology	3	3
V.	2.	Mineralogy	3	3

MINING ENGINEERING.

THIRD YEAR.

Course Numbers.	Courses.	HOURS PER WEEK	
		C. R.	F. & L.
	First Semester.		
II. 4.	Power and Power Transmission	3	
III. 5, 6.	Water and Fuel Analysis		6
IV. 7.	Mechanics of Engineering	5	
V. 4.	Geological Mapping	1	4
V. 7.	Petrology	2	5
VI. 1.	Mining A	4	
	Second Semester.		
III. 7.	Advanced Quantitative Analysis (½ of Course.)		3
IV. 11.	Strength of Materials	5	
IV. 12.	Machine Design	2	4
VI. 2.	Mining B	4	
VII. 1.	Fire Assaying	1	8
VII. 2.	General Metallurgy	3	

MINING ENGINEERING.

FOURTH YEAR.

Course Numbers.	Courses.	HOURS PER WEEK. C. R.	& L.
	First Semester.		
IV. 9.	Mechanics of Fluids	5	
IV. 22.	Mine Constructions		12
V. 5, 6	Economic Geology A	3	3
VI. 4.	Ore Dressing	3	
VI. 5.	Mine Plant	3	
VI. 6.	Design of Mine Plant		3
VII. 5.	Metullurgy of Copper	2	
	Second Semester.		
IV. 19.	Contracts and Specifications	2	
VI. 22.	Mine Constructions		9
V. 5, 6.	Economic Geology, A and B	3	3
VI. 4.	Ore Dressing	2	
VI. 5.	Mine Plant	3	
VI. 6.	Design of Mine Plant		3
VI. 7.	Mine Administration and Accounts	2	
VI. 9.	Examination of Mines	1	6

METALLURGICAL ENGINEERING.

METALLURGICAL ENGINEERING.

THIRD YEAR.*

Course Numbers.	Courses.	HOURS PER WEEK.	
		C. R.	F. & L.
	First Semester.		
II. 4.	Power and Power Transmission	3	
III. 5, 6.	Water and Fuel Analysis		6
III. 7.	Advanced Quantitative Analysis or		6
III. 8.	Electro-Analysis	1	6
IV. 7.	Mechanics of Engineering	5	
VI. 1.	Mining A	4	
VII. 3.	Furnaces	3	
	Second Semester.		
IV. 11.	Strength of Materials	5	
IV. 12.	Machine Design	2	4
IV. 18.	Masonry	5	
VII. 1.	Fire Assaying	1	8
VII. 2.	General Metallurgy	3	

* The courses of the first and second years are the same as those of the first and second years of Mining Engineering.

METALLURGICAL ENGINEERING.

FOURTH YEAR.

Course Numbers.	Courses.	HOURS PER WEEK. C. R.	F. & L.
	First Semester.		
III. 13.	Electric Furnaces	2	
IV. 9.	Mechanics of Fluids	5	
IV. 22.	Mine Constructions		12
VI. 4.	Ore Dressing	3	
VII. 4.	Metallurgy of Lead	3	
VII. 5.	Metallurgy of Copper	2	
VII. 9.	Metallurgical Plant	1	
VII. 9.	Metallurgical Design		3
	Second Semester.		
IV. 22.	Mine Constructions		9
VI. 4.	Ore Dressing	2	
VI. 7.	Mine Administration and Accounts	2	
VII. 6.	Metallurgv of Gold and Silver	5	
VII. 7.	Metallurgy of Iron and Steel	4	
VII. 9.	Metallurgical Design		6

MINING GEOLOGY.

MINING GEOLOGY.

THIRD YEAR.*

Course Numbers.	Courses.	HOURS PER WEEK. C. R.	F. & L
	First Semester.		
III. 5, 6.	Water and Fuel Analysis		6
IV. 6.	Topographical Surveying	5	6
IV. 19.	Contracts and Specifications	2	
V. 3.	Historical Geology	2	
V. 4.	Geological Mapping	1	4
V. 7.	Petrology	2	5
V. 8.	Economic Geology A	3	3
VI. 1.	Mining A	4	
	Second Semester.		
III. 7.	Advanced Analysis		6
V. 6.	Economic Geology A and B	3	3
V. 11.	Petrography	2	4
VI. 2.	Mining B	4	
VII. 1.	Fire Assaying	1	8
VII. 2.	General Metallurgy	3	

*The courses of the first and second years are the same as those of the first and second years of Mining Engineering.

MINING GEOLOGY.

FOURTH YEAR.

Course Numbers.		Courses.	HOURS PER WEEK	
			C. R.	F. & L.
		First Semester.		
V.	5.	Economic Geology A	3	3
V.	9.	Geological Surveying	1	8
V.	14.	Paleontology	2	3
V.	15.	Abstracts	1	
VI.	4.	Ore Dressing	4	
VI.	5.	Mine Plant	3	
VI.	6.	Design of Mine Plant		3
		Second Semester.		
V.	5.	Economic Geology A	3	3
V.	12.	Ore Deposits	2	
V.	16.	Valuation of Ore Deposits	2	6
VI.	5.	Mine Plant	3	
VI.	6.	Design of Mine Plant		3
VI.	7.	Mine Administration and Accounts	2	
VI.	9.	Examination of Mines	1	6

CIVIL ENGINEERING.

CIVIL ENGINEERING.

SECOND YEAR.*

Course Numbers.		Courses,	HOURS PER WEEK.	
			C. R.	F. & L.
		First Semester.		
I.	6.	Calculus.	5	
II.	1.	General Physics	3	6
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
		Second Semester,		
I.	6.	Calculus.	5	
II.	2.	General Physics	3	3
IV.	6.	Topographic Surveying	5	6
V.	1.	General Geology	3	3

*The courses of the first year are the same as those of the first year of Mining Engineering.

CIVIL ENGINEERING.

THIRD YEAR.

Course Numbers.		Courses.	HOURS PER WEEK.	
			C. R.	F. & L.
		First Semester.		
II.	4.	Power aud Power Transmission	3	
IV.	7.	Mechanics of Engineering	5	
IV.	8.	Railway Location	1	8
IV.	9.	Mechanics of Fluids	5	
IV.	10.	Roads and Pavements	2	3
		Second Semester.		
III.	7.	Advanced Quantitative Analysis		6
IV.	11.	Strength of Materials	5	
IV.	12.	Machine Design	2	4
IV.	13.	Graphics	2	6
IV.	14.	Railroad Track, Yard, and Structures	4	

CIVIL ENGINEERING.

FOURTH YEAR,

Course. Numbers.	Courses	HOURS PER WEEK. C. R.	HOURS PER WEEK. F. & L.
	First Semester.		
III. 5, 6.	Water and Fuel Analysis		6
IV. 15.	Stresses	2	
IV. 16.	Structural Details		9
IV. 17.	Water Supply Engineering	5	
IV. 18.	Masonry	5	
	Second Semester.		
IV. 19.	Contracts and Specifications	2	
IV. 20.	Sewerage and Drainage	5	
IV. 15.	Stresses	2	
IV. 16.	Structural Details		9
IV. 21.	Concrete Structures	2	6

DEPARTMENTS OF INSTRUCTION.

I. DEPARTMENT OF MATHEMATICS.

PROFESSOR WALKER.

The study of mathematics is emphasized as a necessary basis for further instruction in the engineering courses. The subjects have been arranged to meet the extensive needs of students in the various branches of engineering, and are treated so as to give the student both logical training and power of application. Care is taken to present both underlying principles and a great variety of concrete applications.

Elementary algebra through quadratics, plane and solid geometry are prerequisites.

1. Advanced Algebra.

A continuation of the algebra required for admission.

Time: Class-room, five hours a week, first semester, three hours a week, second semester.

Text: Hawkes, *Advanced Algebra.*

2. Plane Trigonometry.

Special attention is given to the transformation of trigonometric expressions and to applications involving logarithmic calculation.

Prerequisites: Entrance requirements.

Time: Class-room, four hours a week, first semester.

Text: Granville, *Plane Trigonometry.*

3. Spherical Trigonometry.

Development of the formulae of spherical trigonometry, with applications to problems in astronomy.

Time. Class-room, one hour a week, first semester.

Text: Granville, *Spherical Trigonometry.*

4. Plane Analytic Geometry.

The straight line, the circle, and the conic sections, including a discussion of the general equation of the second degree.

Prerequisites: Courses 1, 2, and 3, of this department.

Time: Class-room four hours a week, second semester.

Text: Smith and Gale, *Introduction to Analytic Geometry.*

5. Solid Analytic Geometry.

An elementary discussion of the geometry of the plane, straight line, and quadratic surfaces.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Time: Class-room, one hour a week, second semester.

Text: Smith and Gale, *Introduction to Analytic Geometry.*

6. Calculus.

The basic principles and formulae of the calculus are developed. Special attention is given to the application of the calculus to problems in geometry, mechanics, and engineering.

Prerequisites: Courses 1, 2, 3, 4, and 5 of this department.

Time: Class-room, five hours a week, one year.

Text: Granville, *Differential and Integral Calculus.*

7. Graduate Subjects.

Courses for graduates will be arranged to suit the members of the classes.

II. DEPARTMENT OF PHYSICS AND MECHANICAL ENGINEERING

MR. KIRCHMAN.

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1. General Physics.

Mechanics, molecular physics and heat are studied.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and Efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Pressure-expansion of gases; (14) Heat-expansion of gases; (15) Archimedes's principle; (16) Calorimetry.

This course is intended not only to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained, but also to give him a better understanding of the laws of physics and of the real significance of physical constants.

Prerequisite: Course 2 of Department I.

Time: Class-room, three hours a week, first semester.
Laboratory, six hours a week, first semester.

Text: Millikan, *Mechanics, Molecular Physics and Heat.*

2. General Physics.

A continuation of Course 1. Sound, light, electricity and magnetism are studied.

Prerequisites: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Text: Millikan, *Light, Sound and Electricity.*

3. Kinematics and Machines.

The object of this broad but elementary course in mechanical engineering is to familiarize the student early in his work with the mechanisms and appliances by which power is generated, transmitted, and utilized; to give him the essentials of the use of tools and machines, and their proper care; and to give him an introduction which shall assist in the subsequent detailed study of machines under the heads of power engineering and mining.

The topics treated are: (a) Nature of machines; methods of transmitting motion in machines; contact mechanisms; friction and tooth gears; cams, link work; trains of mechanisms; chains, ropes, and belts; couplings etc. (b) Classification and comparative description of typical machines; mechanisms of simple engines and pumps; valve and reversing-gears; etc. (c) The care of tools and machines.

Time: Class-room, two hours a week, second semester.

4. Power and Power Transmission.

The various sources of power are discussed briefly, steam and other heat engines as the great sources of power being studied in considerable detail; the boiler and furnace with their accessories; the engine with its connections and controlling mechanism.

Lectures are given on the transmission of power by shafting, gearing, and compressed air; water-power and electric transmission and distribution of power; the general principles of the transmission and transformation of electrical energy.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hutton, *Mechanical Engineering of Power Plants.*

III. DEPARTMENT OF CHEMISTRY.

DR. KEMMERER,
T. H. BENTLEY, Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

It is the intention to secure as perfect a correlation as possible between the lectures, the quizzes, and the laboratory-work, in order that the greatest efficiency in instruction may be attained.

1. Elements of Chemistry.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common elements.

The class-room work consists of lectures in which the chemistry of the elements and their compounds is simplified as much as possible. The more important reactions and theories are illustrated with lecture-table experiments and immediately following the class-room work each student performs as many experiments as possible in the laboratory, carefully recording the results. These records are then corrected by the instructor and returned to the student. Once each week the students are quizzed on both the class-room and laboratory work and once each month the work is reviewed in a written test.

Time: Class-room, five hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Newth, *Inorganic Chemistry.*
Kahlenberg, *Outlines of Chemistry.*
V. Leneher, *Laboratory Experiments in General Chemistry.*

2. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper groups are analyzed. In this manner are studied the metals of all the groups and finally the acids. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze several of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisites: Course 1 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Text: Treadwell & Hall, *Analytical Chemistry, Vol. I.*

3. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

The gravimetric determination of chlorine in a soluble chloride; water of crystallization in copper sulphate; iron and sulphur in ferrous or ferric sulphate; carbon dioxide, calcium, and magnesium in dolomite; silver and copper in a dime; tin, lead, copper, and zinc in a bronze; and silica in an insoluble silicate.

The class-room work consists in lectures on the use and care of balances, crucibles and desiccators, on the selection and use of indicators, on the use, care, and calibration of volumetric flasks, burettes and pipettes, on the methods used in the laboratory from the standpoint of modern chemical theories, in quizzes on these topics, and in the solution of stoichiometric problems involving calculations which are similar to those arising from, and essential to, the laboratory experiments.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. II.*
Fresenius, *Quantitative Chemical Analysis.*

4. Wet Assaying.

A thoroughly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the West. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products. By putting in extra time the ambitious student may greatly increase the number of his determinations and thus become decidedly more expert in this work.

Each student is required to analyze two or more ores for each of the following: Iron, copper, zinc, lead, phosphorus, calcium, manganese, and silica.

Prerequisites: Course 3 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Texts: Low, *Technical Methods of Ore Analysis.*
Sutton: *Volumetric Analysis.*

5. Fuel Analysis.

Analyses of various coals or of other fuels are made and their heat-values are then calculated from these analyses and also determined experimentally by means of the calorimeter. Flue-gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

6. Water Analysis.

Analyses of waters are made in regard to their possible use in boilers. These analyses involve determinations of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 4 of this department.

Time: Laboratory, last ten weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Fresenius, *Quantitative Chemical Analysis.*

7. Advanced Quantitative Analysis.

This course is a continuation of Course 3 or 4. It may be substituted for Course 8. The work will be chosen to suit the needs of each student. It may consist of the complete analysis of rocks and minerals, advanced ore analysis, iron and steel analysis, or the determination of some rare elements.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, one semester.

8. Electro-Analysis.

This course will deal with the practical application of the electric current for determining some of the common metals such as copper, silver, lead, and zinc. After the student has become familiar with the methods used for determining each of these, he will use the current in separating mixtures of metals and as a rapid, accurate method of ore analysis.

The course may be substituted for Advanced Quantitative Analysis, Water and Fuel Analysis, or taken as a special.

Time Class-room, one hour a week, one semester.

Text: Edgar V. Smith, *Electro Analysis.*

9. Inorganic Preparations. (Special.)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 2 of this department.

Time: Class-room, one hour a week, one semester.
Laboratory, six hours a week, one semester.

10. Industrial Inorganic Chemistry. (Special.)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this man-

ner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one semester.
Text: Thorp, *Outlines of Industrial Chemistry.*

11. Organic Chemistry. (Special.)

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room two hours a week, one year.
Laboratory, six hours a week, one year.
Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

12. Physical and Theoretical Chemistry. (Special.)

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro- chemistry and photo-chemistry.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, one semester.
Text: Ewell, *Physical Chemistry.*

13. Electric Furnaces.

The course is designed to furnish the metallurgist and chemist with a knowledge of the practical application of the electric furnace. A small amount of time will be devoted to the history and development of the electric furnace, after which the types of furnaces will be studied with special reference to their industrial application in metallurgical and chemical processes.

Time: Class-room, two hours a week, one semester.
Text: Wright, *Electric Furnaces and Their Industrial Application.*

14. Elements of Practical Photography. (Special.)

The course is planned to furnish the engineer with a working knowledge of photography such as will enable him to use the camera intelligently as an aid in his engineering work.

The class-room work will consist of one lecture a week which will be supplemented by laboratory work in which each student will be required to take and finish a good negative, velox print, platinum print, lantern slide, and bromide enlargement.

Time: Class-room, one hour a week, second semester.

IV. DEPARTMENT OF CIVIL ENGINEERING.

PROFESSOR COGHLAN.
MR. KIRCHMAN.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the work of the fourth year the student is given instruction in Structural, Sanitary, and Hydraulic Engineering. The work, which is largely drawing and design, covers practical problems, with the intent that the student may become thoroughly familiar with the principles governing his profession and with their application.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies, the United States Land Offices, or the United States Geological Survey.

1. Mechanical Drawing and Lettering.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in vaious positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented. The principles of linear perspective are discussed and applied to the representation of some simple objects.

Th latter part of the semester is devoted to special practice in

lettering and in the construction of appropriate and attractive letters for maps and engineering plans.

Prerequisites: Entrance requirements.
Time: Laboratory, eight hours a week, first semester.
Texts: Tracy, *Mechanical Drawing.*
Reinhardt, *System of Lettering.*

2. Mechanical Drawing and Lettering.

A continuation of Course 1. Here the student is made to copy plates from a standard text on drawing. He thereby becomes familiar with the methods of dimensioning, laying out, and reading working drawings. Through the entire course, particular stress is laid upon neat lettering and symmetrical arrangement of drawings. In this course the student is taught how to trace and blue print.

Prerequisite: Course 1 of this department.
Time: Laboratory, six hours a week, second semester.
Text: Anthony, *Machine Drawing.*

3. Descriptive Geometry.

The representation of all geometrical magnitudes by means of orthographic projection, the solution of problems involving points, lines, surfaces and solids, descriptions of and problems relative to warped and double-covered surfaces, intersections of lines and surfaces.

Prerequisites: Entrance requirements and Course 1 of this department.
Time: Class-room, three hours a week, second semester.
Text: Church, *Descriptive Geometry.*

4. General Surveying.

The introductory course in surveying deals with the principles of land measurement, and with the instruments used in both field and office.

In the class-room, the adjustments of the level and transit are taught, and the uses of these instruments in land surveying illustrated by practical problems.

In the field practice, each student becomes familiar with the use of the chain, tape, level, transit, etc., and surveys of streets, mining claims, and building sites are made. Measurements of areas and heights by triangulation methods are also carefully worked out.

Prerequisite: Course 2 of Department I.
Time: Class-room, three hours a week, second semester.

Field, four hours a week, second semester.
Text: Pence and Ketchum, *Surveying Manual.*

5. Mine and Railroad Surveying.

The work consists of field work, recitations, and drafting room practice.

In the field work, a complete survey of a mining claim is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. In addition a complete survey of the underground excavations is made. Practice is also given in the laying out of railway curves and switches.

In the drafting room maps are made from the notes taken in the field practice. The value of careful work in the field and correct notes is thereby emphasized.

In the class-room, the principles of mining law are taught, and problems dealing with the connection of surface and subterranean workings are solved. The methods of computing and laying out railroad curves are studied.

Prerequisite: Course 4 of this department.
Time: Class-room, four hours a week, first semester.
Field, four hours a week, first semester.
Text: Underhill, *Mineral Land Surveying.*

6. Topographical Surveying.

The theory and use of the stadia and other instruments used in making a topographic survey are considered, as are also the methods of topographic surveying. Some time is given to topographic drawing. A complete topographic survey based on a system of triangulation is executed, including the calculations, and platting and completing the map. Some attention is given to the precise measurement of bases and angles.

Prerequisite: Course 4 of this department.
Time: Class-room, five hours a week, second semester.
Field, 6 hours a week, second semester.
Text: Wilson, *Topographic Surveying.*

7. Mechanics of Engineering.

This course deals with the applications of the principles of physics and calculus to the problems of mechanics. The illustrations deal with matters that directly concern the engineer.

Prerequisites: Courses 1, 2, 3, 4, 5, and 6 of department I.
Time: Class-room, five hours a week, first semester.
Text: Church, *Mechanics of Engineering.*

8. Railway Location.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length.

Prerequisites: Courses 4 and 6 of this department.

Time: Class-room, one hour a week, first semester.
Field, eight hours a week, first semester.

9. Mechanics of Fluids.

This course is designed to give the student a working knowledge of the mechanics of fluids. This is a subject of growing practical importance, owing to the increased development of water power in recent years.

The fundamental principles of the theory of hydraulics are studied and some of the most important applications of these principles are explained. The course covers pressure of fluids in tanks and reservoirs, earth pressure and retaining walls, immersion and flotation, gaseous fluids, steady flow of liquids though pipes and crifices, steady flow of water in open channels, dynamics of gaseous fluids, impulse and resistance of fluids.

Prerequisites: Courses 1, 2, 3, 4, 5, and 6, of department I, and Course 7 of this department.

Time: Class-room, five hours a week, first semester.

Text: Church, *Mechanics*.

10. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways; location, construction, drainage, improvement and maintenance of country roads; various paving materials,—broken stone, brick, asphalt, wood and stone blocks, and concrete; foundations for and adaptability of each; arrangement and details of city streets.

Prerequisite: Course 4 of this department.

Time: Class-room, two hours a week, first semester.
Field, three hours a week, first semester.

Text: Baker, *Roads and Pavements*.

11. Strength of Materials.

This course is given with the view of the development of special rules applied to the structural forms in common use. An effort is made to direct the student to some knowledge of the general funda-

mental principles upon which these rules are based in order that he may be in a position to treat new problems as they arise. The laws of stresses and deformations in different materials are discussed, and the method of determining the shearing forces and bending moments in beams are explained. Hooke's law and Bernoulli's assumption are presented in detail, and special emphasis placed on the limitations to their validity. Special applications of the above laws are made in the solution of numerous problems of a practical character.

Prerequisite: Course 7 of this department.

Time: Class-room, five hours a week, second semester.

Text: Church, *Mechanics.*

12. Machine Design.

A study of the design of machine-elements and modern machines. Problems involving calculations of strength of various parts of machines and the adaptation of materials to the design are assigned. Lectures and recitations are carried on, Unwin's *Machine Design,* Part I, being used as a reference. In the draughting-room, the problems taken up in the lectures are made the subject of draughting-work.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, second semester.
Laboratory, four hours a week, second semester.

Text: Low and Bevis, *Manual of Machine Drawing and Design.*

13. Graphic Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 7 of this department.

Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second semester.

Text: Malcolm, *Graphic Statics.*

14. Railroad Tracks, Yards, and Structures.

Instruction is given in the methods of proper location of railroad yards to insure efficiency of operation. The details of track

construction are studied. Each student makes a drawing of some railroad structure, the dimensions being of his own measurement.

Prerequisite: Course 8 of this department.

Time: Class-room, four hours a week, second semester.

Text: Tratman, *Track*.

15. Stresses.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow, and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind, and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisites: Courses 7 and 11 of this department.

Time: Class-room, two hours a week, one year.

16. Structural Details.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures. Each student makes a detailed design of a steel roof truss with its supporting columns, a plate girder bridge for railroad traffic, and a highway Pratt truss span.

Prerequisites: Courses 7 and 11, and course 15 of this department must accompany.

Time: Laboratory, nine hours a week, one year.

17. Water Supply Engineering.

The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, methods of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisites: Courses 7, 9 and 11 of this department.

Time: Class-room, five hours a week, first semester.

18. Masonry.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads

of stone, brick, lime, cements, wood, iron and steel. Special emphasis is placed upon the geological occurrences to the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe and stone arches.

Prerequisites: Courses 7 and 11 of this department.

Time: Class-room, five hours a week, first semester.

Text: Baker, *Masonry Construction.*

19. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, second semester.

Text: Johnson, *Engineering Contracts and Specifications.*
Wait, *Law of Contracts.*
Various standard specifications for reference.

20. Sewerage and Drainage.

A study of the quantity of house-sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisites: Courses 7, 9, and 11 of this department.

Time: Class-room, five hours a week, second semester.

Text: Folwell, *Sewerage.*

21. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisites: Courses 7 and 11 of this department.

Time: Class-room, two hours a week, second semester.

22. Mine Constructions.

Under the head of Mine Construction, the application of the principles of Civil Engineering to the structures most frequently required in mining is taken up. Mine buildings, bins, head-frames, trestles, crane-girders, fast-plants, tanks, etc., are studied as to form and materials of construction. The stresses produced in the members of these structures by the various kinds of loading, and the calculations of these stresses by algebraic and graphic methods are taken up.

In the laboratory the problems incident to design are solved and typical structures are designed and finished drawings made.

Prerequisites: Courses 7 and 11 of this department.

Time: Drafting-room, twelve hours a week, first semester.
Drafting room, nine hours a week, second semester.

V. DEPARTMENT OF MINING GEOLOGY.

Dr. Paul.

This department aims to give its students knowledge concerning bodies of ore and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditions, so that mining may become more and more a business and that the element of chance may be lessened.

1. General Geology.

All of the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory examinations and frequent excursions into the field and is designed to familiarize the student with the data of geology. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail, training in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Limitar mountain, ten miles away, affords other phenomena of vulcanism.

Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Time: Class-room, two hours a week, second semester.
Field, alternate Saturdays, 8:30—5:00.

Texts: Le Conte, *Text-Book of Geology.*
Geikie, *Text-Book of Geology.*
Chamberlain and Salisbury, *Geology.*

2. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts, salts of the organic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's taining, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 2 of Department III.

Time: Class-room, three hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Dana, *Text-Book of Mineralogy.*
Warren: *Notes on Blowpipe Analysis.*
Butler, *Handbook of Minerals.*

3. Historical Geology.

The development of the North American continent with special reference to the United States is taken up to show the past geologic and geographic conditions. It embraces the stratigraphy and the general geologic structure, showing the character of the sediments at different times. Fossils, the time-markers of rocks, are introduced wherever possible and the student becomes familiar with the conditions of deposition and the fossils characteristic of different periods.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, first semester.

Texts: Le Conte, *Text Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Zittel-Eastman, *Paleontology.*

4. Geological Mapping.

Each student is assigned a limited area, often one square mile, and makes a topographic and geologic map of it, the method used being that of compass-traverses, and intersections. The map and report give detailed information as to the rocks; their character, attitude, relative age, and history. Contacts are traced out and plotted, the relation of the various rocks to each other being sought and th estructure studied. The class-room work is devoted to discussion of questions arising in the field.

Prerequisites: Course 4 of department IV, and course 1 of this department.

Time: Class-room, one hour a week, first semester.
Field, alternate Saturdays, first semester.

5. Economic Geology, A.

This course embraces the study of ore deposits, first taking up the formation of open spaces, the filling of these spaces, the classification of veins and the theories of ore deposition. Different classifications of ore deposits are then discussed and examples given of each type of deposit, using Spurr as a text.

In the second half of the course, the iron ores are first considered, then those of copper, gold, silver and gold, silver and lead, lead, lead and zinc, zinc, etc., using Kemp as a text. The course includes lectures and much collateral reading.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, three hours a week, one year.
Laboratory, three hours a week, one year.
Texts: Kemp, *Ore Deposits in the United States and Canada.*
Spurr, *Geology Applied to Mining.*
Clarke, *The Data of Geochemistry.*
References: Posepny, *Genesis of Ore Deposits.*
Beck, *The Nature of Ore Deposits.*
Phillips, *A Treatise on Ore Deposits.*
Bulletins, monographs, folios, etc., of the United States Geological Survey.
Economic Geology and other mining magazines.

6. Economic Geology, B.

This course embraces the study of deposits of non-metallic minerals of economic importance, the geologic aspect being emphasized. The substances considered are coals, oils, gas, clays, cement rock, limestone, salt, gypsum, sulphur, fertilizers, abrasives, gems and minor minerals.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, second semester.
Text: Ries, *Economic Geology of the United States.*
References: Merrill, *Rock-forming Minerals.*
Crosby, *Chemical Geology.*
Mineral Industry of the United States.
U. S. G. S. Publications.

7. Petrology.

In the study of rocks, special emphasis is given to the texture and to the mineral composition as determined by a hand lens and knife, with the purpose of acquiring the ability to make a classification in the field. First, the igneous rocks are studied, then the sedimentary rocks and finally the metamorphic ores.

The study of Petrology should be taken up at the same time as Structural Geology as they can well be correlated.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, first semester.
Laboratory, five hours a week, first semester.

Texts: Kemp, *Hand-Book of Rocks.*
Diller, *Educational Series of Rock Specimens.*

References: Geikie, *Text-Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Geikie, *Structural and Field Geology.*

8. Structural and Dynamic Geology.

In this course, the major and minor structure of rocks are considered, hypotheses and theories being developed where possible, and the bearing on mining geology being constantly in mind. Among the subjects treated are: Classification of igneous rock masses by their shape, mechanics of igneous intrusion, joints, folds, faults, stratification, results of moving shoreline on sediments, formation of limestone, dolomitization, regional metamorphism, contact metamorphism.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, first semester.

Text: Geikie, *Structural and Field Geology.*

References: Geikie, *Text-Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Van Hise, *Treatise on Metamorphism.*
Crosby, *Chemical Geology.*
Clarke, *Data of Geochemistry* .

9. Geological Surveying, A.

In this course, the students are divided into pairs, each pair working on an area of fifteen or twenty square miles. First, reconnaissance trips are made over the district and, later, detailed work is done and the contacts and relative ages of rocks determined. Each pair of students make a geologic map and report of their district, particular attention being given to problems of structure, ore deposits, etc. The Socorro sheet of the topographic maps issued by the United States Geological Survey is used as a base-map.

Prerequisites: Courses 1, 2 and 4 of this department.

Time: Class-room, one hour a week, first semester.
Field, every Saturday, first semester.

10. Geological Surveying, B.

This is more advanced than the preceding course and deals with problems in structural and dynamic geology, petrography, ore deposits, stratigraphy and correlation.

Prerequisite: Course 9 of this department.

Time: Class-room, two hours a week, one year.
Field, eight hours a week, one year.

11. Petrography.

At first enough optics is taken up to familiarize the student with the purpose, use and possibilities of a petrographic miscroscope. Different sections of minerals common in rocks are then studied and identified. This is followed by a detailed study of rock sections containing the minerals previously studied, the end sought being the identification of any rock by means of an examination of a thin section. The admirable collection of rock sections owned by the School is used throughout this course, and at the close each student makes and determines several sections from rocks collected during his field work.

Prerequisites: Course 7 of this department and Course 1 of Department II.

Time: Class-room, two hours a week, second semester.
Laboratory, three hours a week, second semester.

Texts: Rosenbusch-Iddings, *Microscopical Physiography of the Rock-Making Minerals.*
Adye, *Modern Lithology.*
Pirrson, *Rocks and Rock Minerals.*

12. Ore Deposits, A.

Theories of ore deposition are taken up in greater detail than in Course 6 and are subjected to more critical study and the role of igneous rocks in the formation of ore deposits is treated more elaborately than in the latter course. Conditions governing the formation of spaces, water circulation, precipitation and the filling of spaces, replacement, rock alteration and parageneses of minerals are taken up. The original literature is consulted wherever possible and much collateral reading is done.

Prerequisites: Courses 6, 8 and 9 of this department, and Courses 1, 2 and 3 of Department VI.

Time: Class-room, two hours a week, first semester.

Text: Posepny, *Genesis of Ore Deposits.*
Economic Geology.

13. Ore Deposits, B.

This is a continuation of course A and consists of the critical reading of other papers in Posepny's Genesis of Ore Deposits. In the second part, original literature concerning the newer mining camps is studied in an analytical way.

14. Paleontology.

A brief view of the fossils is taken with special reference to the geological succession in Southwestern United States. Characteristic types of each of the geological periods are studied with care. The methods of determining geological horizons by means of fossils are discussed and allusion made to geological correlations.

Prerequisites: Courses 1 and 3 of this department.
Time: Class-room, two hours a week, first semester.
Field and laboratory, three hours a week, first semester.
Text: Zittel-Eastman, *Paleontology.*

15. Abstracts.

Various articles in the current numbers of mining magazines are abstracted by the students and presented to the class.

Prerequisite: Course 5 of this department should accompany or precede.
Time: Class-room, one hour a week, first semester.

16. Special Problems.

It is expected that the student has already become more or less familiar with the various districts in the neighborhood of the School. He is encouraged to take up the exhaustive study of some limited area, in conjunction with, or under the guidance of his instructor, or he is given some area or theme that has already been well worked out and the results published, and he is required to repeat the investigation on his own account. There is a wide range of topics from which to select. Nearly all departments of geology offer problems that are both varied and highly instructive.

17. Valuation of Ore Deposits.

In this course special attention is given to methods of determining the shape, size, and richness of ore deposits; for, on these three factors depend the value of the mine, and the mining methods used in extracting the ore. In considering the dimensions of ore deposits, the general geological relations in the district are first taken up, then the local geological structure is worked out in detail, especial attention being given to contacts, stratigraphy, faults, and joints as criteria for locating cut-off or "lost" ore bodies.

Methods of estimating the amount of probable ore and possible ore in the mine, and the volume of dumps are also discussed. A great deal of importance is attached to sampling; methods of obtaining representative samples, frequency of samples, assay of samples, interpretation of assays, preparation and interpretion of assay maps in determining ore shoots, and methods of guarding against "salting" being discussed. The probable location, amount, and richness thus being determined, development work is put on a more scientific basis and mine valuation (the frequent duty of a mining engineer) is made more exact.

Prerequisites: Courses 5 and 9 of this department.

Time: Class-room, two hours a week, second semester.
Field, six hours a week, second semester.

VI. DEPARTMENT OF MINING ENGINEERING.

Professor Smith.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held cn assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. Mine administration and mining law receive detailed treatment. The entire course is pre-eminently practical in character.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valueing property, properly reporting propositions submitted for investment, calculating the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaptation of the steam shovel and stripping methods to western metal mines are treated at considerable length in the course on Mining Methods.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives detailed consideration.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Examination of mineral properties; relation of topography to geological structure; tracing of probable outcrops.

Prospecting by ditches, pits and deep borings.

Development; choice of methods; location of openings.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts, submarine blasting; quarrying.

Tunnelling: Methods of driving and timbering; submarine tunnels; permanent linings; sizes, speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Surface workings and hydraulic mining.

Prerequisites: Courses 1, 2 and 4 of Department I; Courses 1, 2, and 3 of Department II; Course 1 of Department III.

Time: Class-room, four hours a week, first semester.

Texts: Hoover, *Principles of Mining.*
Gilette, *Rock Excavations.*
Foster, *Ore and Stone Mining.*

2. Mining, B.

The subects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Water supply.

Drainage: Sources, control and raising of mine waters; dams; drainage-levels.

Ventilation: Requirements for pure air; vitiation and purification of mine-air; methods of ventilation; measurement and control of air-currents.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisite: Same as for preceding course.

Time: Class-room, four hours a week, second semester.

Texts: Same as in Course 1.

3 Inspection of Mining Methods.

By inspection of mining methods followed in the various camps in the neighborhood of the School there is afforded great variety of illustration of the themes developed in the lectures.

The inspections are carried on partly as class-work in company

with the instructor in charge, and partly as individual work. Full notes are required to be taken and these are subsequently reduced in the office to proper form, accompanied by the necessary sketches and plans to make the whole procedure thoroughly intelligible.

Required as a two-weeks' trip to be made by all students of Mining Methods.

4. Ore Dressing.

An advanced course, the elements having been taken in General Metallurgy. In it is comprised a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil and acid flotation.

Prerequisites: Course 1 of Department I; Courses 1 and 2 of Department II; Course 9 of Department IV.

Time: Class-room, three hours a week, first semester; two hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration.*

5. Mine Plant.

The following machinery and appliances are studied and critically discussed.

Hoisting: Engines, drums, wire rope, skips and cages; head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiencies of fans.

Air-compressors: Straight-line and duplex; simple and compound compression; heat of compression; conveyance of compressed air; efficiencies.

Machine drills: Construction and operation.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives; comparative efficiencies.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, three hours a week, one year.

6. Design of Mine Plant.

The student is assigned problems relating to a given mine. He makes the requisite surveys, plans the top-works, designs the requisite machinery for a specified duty, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or of the Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings. This work, when further elaborated, may be accepted as a thesis.

Time: Laboratory, three hours a week, one year.

7. Mine Administration and Accounts.

Particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of supplies, and the sale of ore prepared for market are taken up, and mine accounts, statements of cost, and monthly reports are discussed.

Time: Class-room, two hours a week, second semester.

8. Mining Law.

A short course of lectures on mining law (particularly in relation to the manner of locating placer, lode, and tunnel claims), on water rights, law of the apex and similar questions is given by legal practitioners at intervals during each year. All students are expected to attend.

9. Examinations of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the

mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside constructions, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant.

Time: Class-room, one hour a week, second semester.
Field, six hours a week, second semester.

COAL MINING ENGINEERING.

As New Mexico contains about ten million acres of coal land, and as this coal land is beginning to be developed on a large scale, it has been thought advisable to offer some special courses in Coal Mining Engineering.

Five operating coal mines are within twenty-five miles of the School, and are open for inspection and study. Some of the model coal mines and coking plants of the country are located in the northern part of the Territory and the Christmas vacation can be spent with an instructor inspecting these operations.

The Cerrillos Anthracite District is another profitable field for inspection trips.

If five students signify their intention of taking up Coal Mining, the following courses will be offered the first semester: Geology of Coal, Coal Mining Methods, Coal Breaking and Coking. Prospective students in this work are requested to communicate with the School at their earliest convenience, giving a statement of their study, training and experience in coal mining.

Geology of Coal.

In this course the origin of coal, the different kinds of coal, the structure of coal, its variations and irregularities, and the nature of the outcrop are considered. Features such as geologic structure and associated rocks common to all coal fields are then discussed, followed by a detailed study of the different coal fields, with a view of familiarizing the student with the geologic features of coal and

the large features common to coal fields. A real geological mapping of a coal mining region is also carried on with a view of determining the method of access to a certain coal seam (shaft, slope, or drift), and the best location for the mouth of the workings.

Coal Mining Methods.

The methods of breaking the coal dependent on its structure, attitude, and thickness are first taken up, followed by descriptions of the different systems of coal mining such as room and pillar, long wall advancing, long wall retreating, mining in benches, etc. The different systems of haulage; animal, endless rope, main-and-tail rope, compressed air, electric locomotives, etc., are taken up. The subject of ventilation receives considerable attention, as does the subject of mine explosions.

Coal Breaking and Coking.

Devices used in handling and breaking and sizing coal for market are first considered, followed by a discussion of machines used for washing coal. Then the study of coke manufacture is taken up; first the quality of coal suitable for coking, its preparation for the ovens, and then a critical study of the different kinds of coke ovens, methods of charging, time of burning, and method of drawing the coke. During the Christmas recess an inspection trip is made to the Raton Field where the different features of coal mining can be seen at their best.

VII. DEPARTMENT OF METALLURGICAL ENGINEERING.

PROFESSOR SMITH.
MR. KIRCHMAN.

The aim of the Metallurgical Department is to give its graduates a thorough working knowledge of assaying, chemistry, millwork and smelting processes; and to equip them with the knowledge necessary to the successful management of metallurgical plants, or to take charge of metallurgical operations.

The course has been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals. This special training is given by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead: The crucible-assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assays are considered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until

he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Courses 1, 2 and 3 of Department III, and Course 2 of Department V.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Texts: Lodge, *Notes on Assaying.*
Furman, *Manual of Practical Assaying.*

2 General Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

Particular stress is laid upon the study of the more recent metallurgical practices and improvements of older processes.

The course is supplemented by visits to neighboring plants and, at the end of the school-year, by vacation trips of metallurgical inspection.

Prerequisites: Course 1 of Department III; Course 1 of Department II, and Course 2 of Department V must precede or accompany.

Time: Class-room, three hours a week, second semester.

Texts: Roberts-Austen, *Introduction to the Study of Metallurgy.*
L. S. Austin, *Metallurgy of the Common Metals.*

3. Furnaces.

This course is given by way of an extension of the topic "furnaces" as treated in General Metallurgy. It is concerned with the theories of high temperature generation, heat conservation, measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three hours a week, first semester.

Text: Demaur, *Industrial Furnaces.*

4. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet types of ore hearth; smelting lead ores in

the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.
Time: Class-room, three hours a week, first semester.
Text: Hoffman, *Metallurgy of Lead*.

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.
Time: Class-room, two hours a week, first semester.
Text: Peters, *Principles of Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel processes; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.
Time: Class-room, five hours a week, second semester.
Texts: Rose, *Gold.*
Collins, *Metallurgy of Silver.*

7. Metallurgy of Iron.

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron; gray cast-iron and spieged-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.
Time: Class-room, four hours a week, second semester.
Text: Howe, *Metallurgy of Steel.*

8. Metallurgical Inspection.

Visits of inspection to mills and reduction-works. While these visits are required during the third year only, at which time the student is capable of understanding all he sees and thus deriving the maximum amount of benefit from it, students not so far ad-

vanced are advised to take these trips whenever it does not conflict with other studies.

A visit may be extended by special permission and the mill or reduction-works used to furnish the material for a thesis.

9. Metallurgical Plant and Design.

Some time during the latter part of the general course in metallurgical engineering, the student devotes a part of his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two students have the same work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans for part of the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bills of materials made out for the portions of the work assigned, and the cost of the several parts carefully estimated according to the trade conditions and labor factors existing at the time. The entire work and all computations are carried out according to the best engineering practice and with the same care that actual construction opertions require.

Prerequisites: Courses 7, 9, 11, and 19 of Department IV; Course 6 of Department V; and Course 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, three hours a week, first semester, and six hours a week, second semester.

VIII. DEPARTMENT OF LANGUAGES.

PROFESSOR DRAKE.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge; for, in Socorro and vicinity, Spanish is as generally spoken as English.

Either French or German may be taken in place of Spanish if a sufficient number of students apply.

The course in German continue through two years. No particular attention is given to the speaking or writing of this language. The chief aim is to put the student into possession of a useful instrument for his major line of work.

The importance of a reading knowledge of both German and French cannot be emphasized too strongly, as a vast store of information necessary to the engineer and scientist is locked up in these languages. By the end of the second year the student should be able to read readily the scientific and technical books which are of use to him in his work.

The course offered in French continues through two years. The chief aim in this course, as in the coures in German, is to give the student such a reading knowledge of the language as will be of practical use to him in the pursuit of his special line of work. At the end of the course the student is expected to be able to read French with sufficient ease to use French text-books and other publications in the pursuit of his technical studies.

1. Spanish. (Optional.)

The work is based on Worman's First and Second Spanish Readers. A part of the class exercise each day consists in cross-translations, both oral and written. Special stress is placed upon con-

versational exercises. Attention is given to the elementary principles of the grammar of the language, especially to conjugation.

Time: Two and a half hours a week, one year.

Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish. (Optional.)

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar* being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.

Time: Two and a half hours a week, one year.

3. German. (Optional.)

The first year's work in this course is elementary. It consists of study of grammar and easy readings. Practice in speaking and writing the language is not insisted upon any further than is needed in fixing the main principles of construction in the mind.

Time: Two and a half hours a week, one year.

4. German. (Optional.)

The second year's work in German consists in the reading of narrative and descriptive modern prose and a drama of Lessing or Schiller. The study of grammar is continued. Sight-reading forms a large part of the exercises of the second term. The reading texts are changed from year to year to avoid repetition and to give students who may desire an opportunity to take more than the required amount of German.

Time: Two and a half hours a week, one year.

5. French. (Optional.)

The first year's work is elementary. Fraser and Squair's *French Grammar* and *Le Roman d'un Jeune Homme Pauvre* form the basis of the work. The text-book for reading is changed from year to year, however, to give students who may wish it an opportunity to read more than the required amount of French. Easy readings are assigned for work outside the class-room with a view to examination.

Time: Two and a half hours a week, one year.

6. French. (Optional.)

Effort is still concentrated upon reading. The student is expected to be able at the end of this course to read with sufficient ease to make practical use of French text-books and periodicals in his other studies. The study of grammar is continued. *La Petite Fadette, Le Cid, Le Misanthrope* and *Athalie* are the texts from which the readings are selected.

Time: Two and a half hours a week, one year.

PHYSICAL TRAINING.

MR. KIRCHMAN.

Physical training has become a distinct feature of the student's activity at nearly all institutions of higher education. Rationally indulged in it is an exceedingly valuable feature, as is attested by both reason and experience. It is superfluous to argue that a sound mind and an unsound body constitute a very unfortunate combination. The ideal young man of the day, the young man who gives promise of greatest usefulness, is sound in both mind and body. The health of the body and the consequent health of the mind can not be promoted without proper attention to the laws of physical exercise. Physical training thus becomes, as it should become in an educational institution, a valuable means for the accomplishment of the very end and aim of the institution itself.

At the School of Mines athletics has been receiving increased attention in the last few years. There is now a well organized athletic association, and foot-ball, base-ball, basket-ball, lawn tennis, and track events are dividing the attention of the members of the association. The foot-ball and base-ball teams made a good record for themselves last season and they are confidently anticipating better records for 1910. It is to be hoped that an intercollegiate athletic association will soon be organized among the students of the respective collegiate institutions of New Mexico; in fact, the subject of the organization of such an association has already been considerably discussed. When the organization is perfected, the School of Mines may be expected to give a good account of itself in an athletic way.

Care is taken, however, and will continue to be taken to make athletics merely a means of keeping the young men at the School of Mines in the best possible physical condition to do the work for which they came to the institution. While it accomplishes this purpose it naturally fosters and develops a strong college spirit, and this, too, is a species of enthusiasm that is by no means to be despised in the work of educating young men for the activities of their later years.

THE ACADEMY.

The requirements for admission to the Academy are the same as those for standard secondary schools. A two-year course is offered, the work therein corresponding to that of the ninth and tenth grades of the standard high school.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done, There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

FIRST YEAR—FIRST SEMESTER.

Elementary Algebra.

To the subject of simultaneous linear equations. Special drill is given in factoring.

Time: Five hours a week.

Text: Wells, *Algebra for Secondary Schools.*

English I.

The Merchant of Venice, Bunker Hill Oration, and Snowbound are read and discussed in class. Some memorizing of significant passages is required. In the composition work, an attempt is made to interest the student at once in narrative writing, fluency and correctness of expression being sought primarily. Later in the year the work verges into exposition. During this semester each student is required to read and pass an examination in two of the following supplementary books: Ivanhoe, Tales from Shakespeare, Autobiography of Franklin, Tom Brown's School Days, Robinson Crusoe, The First Jungle Book, and Pilgrim's Progress. Reading Course examinations are held about the middle of November and the first of January.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physical Geography.

Wherever possible, in this course, facts obtained by actual observation are made to verify and supplement the text used. There

are daily assigned observations of clouds, winds and temperature, and a study of erosion by wind and by water and of geologic formation is made in excursions to near-by arroyos and canyons. In connection with the study of stream-flow, attention is called to the great importance of forest preservation to the people of he West.

Time: Five forty-five minute periods a week.

Text: Fairbanks, *Practical Physiography.*

FIRST YEAR—SECOND SEMESTER.

Elementary Algebra.

The first semester's work is continued through the subject of quadratic equations. Special attention is given to the statement of problems and to the solution of literal equations.

Time: Five hours a week.

English I.

A continuation of the first semester's work in this subject. Shakespeare's Tempest, Eliot's Silas Marner, and Bryant's Sella and Thanatopsis are read and discussed in class. As in the first semester, each student is required to read and pass examination in two of the supplementary books offered in this course. These examinations will be given in March and May.

Latin I.

The text begun in the first semester is completed and thoroughly reviewed; the "Prose Selections" are finished and re-read.

Time: Five forty-five minute periods a week.

Botany.

Plants, shrubs and flowers of the surrounding country are studied and analyzed. Germinating seeds and unfolding plants are studied, and considerable free-hand drawing, to aid the student to fix these observations in memory, is required. The evolutionary and inter-relating aspect of plant life is presented.

Time: Five forty-five minute periods a week.

Text: Bergen, *Elements of Botany.*

Supplementary reading: Stevens, *Introduction to Botany.*
Gray, *School and Field Botany.*
Bessey, *Botany.*

SECOND YEAR—FIRST SEMESTER.

Elements of Goemetry.

The first three books of the text are completed. Nearly one-half of the time is devoted to the solution of original exercises in demonstration, construction and computation.

Prerequisite: Elementary Algebra.

Time: Five hours a week.

Text: Wells, *New Plane and Solid Goemetry.* L

English II.

Julius Caesar, Richard III, and the Letters of Washington are studied in class. The same plan is pursued in the writing work as in English I. This semester each student is required to read and pass examination in two of the following supplementary books: Tale of Two Cities, David Copperfield, Hoosier Schoolmaster, Last of the Mohicans, Vicar of Wakefield, and assigned portions from The Sketch Book. These examinations will be given as in English I.

Time: Five forty-five minute periods a week.

Text: Scott and Denny, *Composition-Literature.* L

Physics.

This course runs throughout the entire year, the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. The splendid equipment of physical apparatus renders it possible to supplement the text by daily experiments and demonstrations. During this semester the subjects of mechanics and heat are treated.

Time: Five hours a week.

Text: Millikan and Gale, *First Course in Physics.*

Biology.

The work as outlined here pre-supposes a knowledge of elementary physiology. The aim is to familiarize the student with the structure, function, and development of animals. The method of study is four-fold: First, careful observation of the specimen in hand, including dissecting and use of the microscope; second, pen-sketching of important organs; third, reference reading and discussion of obscure points; fourth, lectures and quizzes. Beginning with the study of the protozoa in water the course is pursued through the study of the structure and functions of Sponges,

Polyps and Medusæ, Corals and Worms. A few slime-molds are included. The Metamorphosis of Insects and their adaptations to environment receive emphatic attention. The evolutionary aspects of animal life are stressed throughout.

Time: Four hours a week.

Texts: Jordan and Kellogg, *Animal Life.*
Sedgewick and Wilson, *General Biology.*
Marshall and Hurst, *Practical Zoology.*
Huxley, *Crawfish.*

SECOND YEAR—SECOND SEMESTER.

Elements of Geometry.

The remaining books of the text, including Solid Geometry, are completed.

Time: Five hours a week.

English II.

Macbeth, Henry V, The Idylls of the King, and the minor poems of Milton are studied in class. The remainder of the supplementary books are treated as in English I. The writing work is a continuation of the first semester's methods.

Time: Five forty-five minute periods a week.

Physics.

This is a continuation of the first semester's work. Electricity, sound, and light are treated in much the same manner as the subjects of the first half of the year.

Time: Five hours a week.

History.

For the benefit of those who have not had the opportunity to study Ancient History a brief review of that subject is made. Grecian and Roman History are given their proper emphasis. Special attention is paid to the History of Western Europe since the barbarian invasion, with emphasis on the bearing of old-world events upon the history of the Americas. In the study of such things as the mediaeval town, life in the feudal castle, and the Renaissance, an attempt is made to cause the student to realize these things as aspects of the daily existence of common men and women, which he would have lived likewise under like conditions, rather than to obtain a fixed mental chronology of dates and occurrences. Frequent written reviews are given throughout the course. Essays on certain assigned historical subjects are required.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus is situated on the northwest edge of Socorro. It contains 20 acres of nearly level ground within the irrigable belt. Groves of trees have been planted and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet deep, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite in broken ashler and is trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated, heated with a good hot-water system, piped for water and gas, and wired for electricity for illumination and for experimental purposes.

As now arranged the main floor of this building contains the president's office, the general library, the chamical laboratory, instructor's office, assay-laboratory, balance-rooms, and lecture-room, The basement contains the mineralogical museum, lecture-room, chemical supply-room, boiler-room, engine-room, lavatories, and general storage-rooms. A lecture-room occupies most of the second story. The third story includes a lecture-room, supply-room, photographic dark-room, and storage closets.

Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion the building is to be X-shaped, the central pavilion two stories and the four wings one story. With its spacious rooms it will be peculiarly adapted to engineering instruction.

When the building is completed the entire north wing will be devoted to draughting purposes, the light coming from above. At present the main draughting-room is in the south wing which also is a lecture room. Off this are the instructor's office and a blueprint room. A photographic room is fitted up in the main building.

Dormitory.

The School of Mines suffered long for lack of dormitory accomodations. In fact, it is known that many students who would otherwise have come to the School of Mines in years past have gone to other institutions because of the lack of the lower cost of living which a dormitory here would have afforded. However, the $15,000 generously appropriated by the territorial legislature has now been expended with the result that the School of Mines is equipped with what is probably the best dormitory in New Mexico. The building is heated with hot water and lighted with electricity. There are a dining room and kitchen in connection, also a bath room on each of the two floors and a shower bath in the basement. The assembly room on the first floor, which is now equipped for the accommodation of the academic department, promises to meet all the requirements of that department for some time to come. The building is designed to afford accommodation for about thirty students and is now occupied to practically its full capacity. The dormitory contributes greatly to the convenience and comfort of the students in attendance at the School of Mines and is sure to be one important agency in increasing that attendance.

It has already been demonstrated that students can be accommodated with board and lodging at the dormitory at the rate of $20 a month, they being required to furnish only their own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture. After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application.

EQUIPMENT.

Chemical Laboratories.

The chemical laboratories have recently been greatly enlarged and improved. As now arranged they occupy the entire south wing of the main building, while the store rooms, private laboratory, and chemical lecture room are located in the central section of the same building. Elements of chemistry and qualitative analysis are taught in the large laboratory on the main floor. The room, which is exceptionally well lighted and ventilated, is equipped with large hoods, a balance room, and twenty-four desks, each of which is supplied with gas, water, and electric light.

The basement laboratory has recently been remodeled and fitted with large windows, glass partitions, and modern desks. The east half of it is used for quantitative analysis and wet assaying. There are large hoods in each end which are supplied with hot plates and drying ovens, while each desk is equipped with an Alberine stone sink, water, gas, and electric light.

In the west half of the basement there are the instructor's laboratory, electro-chemical laboratory, and balance room. In the latter the balances are supported upon a solid concrete table which is entirely free from vibration. In the electro-chemical laboratory there is now being installed a modern storage battery plant consisting of a motor generator, storage cells, and a switch board so arranged that each student may obtain any current he desires for analytical or other electro-chemical purpose. The laboratory is also supplied with 110 volt alternating current which is used for small crucible and combustion furnaces.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types and large muffle-coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes, and other assaying materials and supplies.

A weighing-room containing a number of Becker's balances is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge

ore-crusher and a Bolthoff sample-grinder and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers, and other necessary apparatus.

Physical Laboratory.

The physical laboratory is on the third floor of the main building and contains the usual apparatus for illustrating the facts and laws of physics. In addition there has just been added at a considerable expense all the apparatus necessary to perform the quantitative experiments outlined in Course 1 of Department II.

Petrographical Laboratory.

For the microscopic study of rocks both in elementary and advanced or graduate work the School is well supplied with microscopes and other necessary apparatus. There has recently been added to the equipment a new style large microscope manufactured especially for this institution by Reichert of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model sub-stage with rack and pinion, an Abbe sub-stage condenser with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objectives and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparatus, stage micrometer, drawing apparatus, quartz-wedge, quarter-undulating micaplate, and other necessary pieces.

A rock-slicing machine with power attachments enables the student to prepare thin sections of the rocks which he is studying.

Among the series of thin-slices of rocks are a collection of types of the massive crystallines of Europe prepared by Krantz of Bonn and completely illustrating Zirkel, sets of Maryland massives, and other American rocks and minerals. The Sturtz collection of European rocks illustrating Rosenbush and large miscellaneous collections are expected to be soon available for study.

Engineering Department.

For land, railroad, and mine surveying the department has full sets of instruments, including transits, levels, poles, leveling-rods, chains, pins, steel-tapes, hand-level, compasses, and clinometers.

The department has lately added to its equipment a fine large engineer's transit and all accessories manufactured expressly for this institution after improved designs by the Gurleys of Troy. There is included an extension tripod, auxiliary telescope, reflector, gradienter attachment, diagonal prism, and solar apparatus.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the engineering building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame on steel track, developing-vat, and drying-rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. Provision is also made for models and illustrative materials.

The photographic room is located in the main building.

Mineralogical Museum.

The school owns a very fine collection of minerals of all kinds. These properly labeled and arranged in glass cases are housed in the north wing of the main building.

The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school it attracted wide attention.

The display was planned to center around a large colored relief-model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model was shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases, were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals which for variety, delicacy of coloration, and beauty have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the museum of the School of Mines.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats and atlases, and volumes on history, travel, and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.
Mining and Scientific Press.
Engineering Record.
Power.
Engineering News.
Mining Science.
Mines and Minerals.
Engineering Magazine.
American Chemical Journal.
Journal of Industrial and Engineering Chemistry.
Chemical Abstracts.
Western Chemist and Metallurgist.
Review of Reviews.
Economic Geology.
School of Mines Quarterly.
New Mexico Journal of Education.
All the U. S. G. S. Publications.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions and authors' separates, pertaining to the respective divisions.

Powell Library.—The School has come into possession of the private library of the late Major John W. Powell of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology, and philosophy, many of which are rare and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great southwest. It was in these fields that Major Powell did most of his work which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this

famous man, who had been so long identified with this western country, should find a permanent home in New Mexico.

THE TORRANCE MINE.

The School of Mines has become the owner of the Torrance gold and silver mine at the base of the Socorro mountain only about two miles from the School campus. This mine affords excellent opportunities for the practice of mine-surveying and for a study of all the various features of practical mining. Here are to be studied a double-compartment incline shaft, a fine example of mine-timbering, various levels, cross-cuts, winzes, shafts, stopes, ore-bodies with associated geological structures, and many other features of interest to the student of mining engineering.

INSPECTION VISITS.

Students in the mining and metallurgical courses are expected to make a two weeks' tour of inspection of the mines, concentrators, and smelters lying within easy reach of Socorro under the direction of the professor of mining and metallurgy. This tour may be made either during the Christmas vacation or at the close of the school year. Special stress is laid upon the proper keeping of notes. These are fully written up each day and are made use of later as a basis of other work in connection with the regular courses. If carefully kept they prove valuable references in later years.

Inspection visits have been made to the mines, concentrators, and reduction works at El Paso, Douglas, Bisbee, Tombstone, and Cananea.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is twenty-five dollars a semester except to citizens of New Mexico, the tuition fee for the latter being ten dollars a semester. This is payable at registration and its payment after matriculation admits the student to all class-room instruction.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water, and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Quantitative Analysis, Water and Fuel Analysis, Advanced Analysis, Inorganic Preparations, Organic Chemistry, each $5.00; Qualitative Analysis, Wet Assaying, each $7.50; Fire Assaying, $10.00; Mineralogy (Blowpipe Analysis), $3.00.

A deposit of $2.00 is required from each student who registers for any one of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due for the breakage of apparatus.

Graduation Fee.

The graduation fee, payable before delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer	$10.00
Bachelor of Science	5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month; board at the hotels and best boarding-houses for $6.00 a week. The cost of living at the dormitory is $20 a month.

BOOKS.

Books are furnished to the students at cost.

SCHOLARSHIPS AND PRIZES.

Scholarships.

Through the generosity of the members of the Board of Trustees, of the Thirty-seventh General Assembly of New Mexico, and of the Allis-Chalmers Company, the New Mexico School of Mines has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

School of Mines State-Scholarships.—To one student from each state of the Union is open a scholarship yielding free tuition. Each scholarship may be held for one year and is assigned to that applicant who shows the greatest proficiency in subjects already pursued by him. Application must be made in writing to the President and in the case of those who have not been students in the School must be accompanied by a certified statement of subjects pursued and the grades received therein unless the applicant prefers to pass an examination in the subjects for which he seeks credit.

School of Mines County-Scholarships.—Scholarships are open to two students from each county in New Mexico. These scholarships yield free tuition and are subject to the same conditions as the State-Scholarships.

New Mexico Scholarships.—The Thirty-seventh General Assembly of New Mexico gave to each representative, to each councilman, and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the territory and provided an appropriation of $200.00 for each appointee.

Allis-Chalmers Scholarship.—To one member of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee, and Scranton, an opportunity for four months' study and employment in any of its plants and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an

exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Prizes.

The Brown Medal.—Hon. C. T. Brown of Socorro offers annually a gold medal to the student who, while doing a full year's work, has shown the greatest proficiency in the courses in Wet Assaying and Fire Assaying. The medal is awarded each year at commencement. Only those students are eligible as contestants for the medal who at commencement are found to have completed the courses named and, of course, the prerequisites to these courses.

SUMMER WORK.

The proximity of the School to mineral properties, mines, and smelters makes it easy for the student to secure employment during the summer (and during the Christmas vacation, if desired) and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years land-surveying, mine-surveying, geological surveying, assaying and mining, have been attractive fields of work for the students during the vacations.

DEGREES.

The degree of Bachelor of Science, Mining Engineer, and Civil Engineer are conferred by the Board of Trustees upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of this institution, have completed the prescribed collegiate courses of any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed courses of the four-year curriculum in Mining Engineering, Met-

allurgical Engineering, or Mining Geology, has presented an original and satisfactory dissertation in the line of his work, and has done two years of professonal work of which one has been in a position of responsibility. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum, and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the mining engineer, except that the candidate substitutes, in some of his later work, courses which relate more directly to the profession he expects subsequently to follow.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but in each case the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidence of independent investigation to warrant its publication in whole or in part.

COMMERCIAL ANLYSES.

The wide demand which exists in the great mining district of the southwest for disinterested and scientific tests and practical investigations has led to the establishment by the New Mexico School of Mines of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible and accurate results assured by reason of the exceptional facilities of the laboratories of the School and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said

institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines.

A special circular is issued, giving the schedule of charges, other necessary information, and methods of preparing and shipping samples. Copies are mailed on application. By special resolution it is required that all charges shall be paid in advance.

Commercial Assaying.—The assaying for gold, silver, copper, lead, zinc, and the common metals is carried on in all its various phases. All work is run in duplicate and, in case of any non-concordant results, such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese, and the rarer metals such as uranium, vanadium, nickel, and cobalt are made according to the best methods.

Water Analysis.—The chemical analysis of waters for city-water supplies, boilers, and domestic use, and of mineral and mine-waters has of late assumed great importance. The chemical laboratory of the School is fully equipped for this work and in the case of bad waters remedies and methods to be used to improve the waters for specific purposes are suggested. A large number of analyses of waters from the southwest have already been made and very interesting results obtained.

Fuel Analysis.—Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coals of the region. Complete analyses and heat tests have been made of some of the principal deposits. With the work already done the results of new analyses are made of special value on account of the comparative figures that can be supplied.

DIRECTORY OF GRADUATES AND FORMER STUDENTS.

ARTHUR H. ABERNATHY. Mapimi, Mexico.

Student, 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, 1901; Assistant sampleman, Minera de Penoles Co., Mapimi, Durango, Mexico, 1909.

C. E. BARCLAY. Maria, Texas.

(A. B. University of Virginia.)
Student, 1896-97. From Bowling Green, Kentucky.

JAMES F. BERRY. Zacualpan, Mexico.

Student, 1904-5. From Socorro, N. M. Assayer with American Smelting and Refining Company, at Aguas Calientes, 1905; Assayer City of Mexico, 1906-7; Chemist, Cia Metalurgica y Refinadora del Pacifico, Fundicion, Sonora, Mexico, 1907-8.

LOUIS AUGUST BERTRAND. Upland, Nebraska.

Student, 1895-6. From Conway, Iowa. Student Ecole Professionella de l'East, Nancy, Lorraine, 1890-95; Instructor in Mathematics and French, New Mexico School of Mines, 1895-96; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Company, Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Superintendent, Compania Mineros de Penoles, Mapimi, Durango, Mexico, 1901.

CHAUNCEY E. BUTLER.* Dedrich, California.

Student, 1893-6. From Kelly, New Mexico. Assayer, Cibolo Creek Mill and Mining Company, San Francisco, California, 1896; Assayer and Furnace Superintendent, La Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897-98; Chemist and Assayer, United Verde Copper Company, Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Company, and Jenny Lind and Maple Mining Company, Dedrich, California, 1903.

R. HARLAND CASE. Colorado Springs, Colorado.

Student, 1902-5. From Cerrillos, N. M. Chemist, Compania Metalurgica de Torreon, Torreon, Mexico, 1905-6; Assistant Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906; Assistant-Manager, Stephen-

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† Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

* Deceased.

son-Bennett Mining and Milling Company, Organ, New Mexico, 1906-7; Consulting Engineer, Western Mining, Milling and Leasing Company, Colorado Springs, Colorado, 1907-8.

EDWARD C. CHAMNEY. Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-1; Assayer, Oro Mining Company, Minnehaha, Arizona, 1901.

VIVIAN V. CLARK. Reiter, Washington.

Student, 1896-8. From Kelly, New Mexico. Assayer, Bland Mining Company, Bland, New Mexico, 1898-9; Superintendent, Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine Operator, Albuquerque, New Mexico, 1902; Manager, Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903; Consulting Engineer, Consolidated Exploration Mines Company, New York, and allied syndicates, 1909—.

DAVID JOSHUE CLOYD. Torreon, Coah., Mexico.

Student, 1899-1900. From Decatur, Illinois. Chemist and Assayer, Wardman's Assay Office, Aguas Calientes, Mexico, 1900-1906; Assistant Superintendent, Cia Minera del Tiro General, Charcas, S. L. P. and Assistant Superintendent, Cia del Ferrocarril Central de Potosi, Charcas, S. L. P., 1906-8; Assayer and Chemist, Dailey, Wisner & Company, Torreon, Coah., Mexico, 1908.

SAMUEL COCKERILL. Milwaukee, Wisconsin.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-6. From North Fork, Virginia. Post-Graduate Engineering Course, Allis-Chalmers Company, 1906-8; Milwaukee Coke and Gas Company, 1908—.

LEON DOMINIAN. Mexico City, Mexico.

(B. A., Roberts College, Constantinople, 1898; C. I. M. Mining School, University of Liege, 1900.)

Graduate Student, 1903-4. From Constantinople, Turkey. Assistant, U. S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-4; Engineer to Victor Fuel and Iron Company, Denver, Colorado, 1904-6; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-7; Consulting Engineer, Mexico City, Mexico, 1908.

ROBERT CASIANO EATON. Leon, Guanajuato, Mexico.

Student, 1893-4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1894-8; Superintendent, Muriedas Smelting Works, Xichu, Guanajuato, Mexico, 1898; Superintendent, Pozo del Carmen Railroad, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager, Nuevo Cinco Senores Mining and Milling Company, Comanja, Jalisco,

Mexico, 1902-4; Independent Assayer and Ore Buyer in Leon, Gto., Mexico, since 1904.

ALEXANDER WALTER EDELEN. Angangueo, Michiocan, Mexico.

Student, 1905-6. From Baltimore, Maryland. Assistant Superintendent, Elkton Consolidated Mining and Milling Company, Elkton, Colorado, 1906; Superintendent Minas Bonanzas y Anexas, Zacatecas, Mexico, 1907-1909; Mine Superintendent, American Smelting and Refining Company, Anangueo, Michiocan, Mexico, 1909—.

THADDEUS BELL EVERHEART. Pueblo Nuevo, Durango, Mexico.

Student, 1905-7. From Bells, Texas. Assayer and Surveyor, Pereguina Mining and Milling Company, Guanajuato, Mexico, 1907-8; Mill Superintendent, Las Animas Mining and Milling Company, Pueblo Nuevo, Durango, Mexico, 1909—.

HARRY THORWALD GOODJOHN. Torreon, Coahuila, Mexico.

Student, 1902-3. From Pittsburg, Texas. Assayer, Cia. Metalurgica del Torreon, State of Coahuila, Mexico, 1903-1906; Chief Chemist, Mapimi Smelter, 1906; Chemist and Metallurgist, Cia. Minera, Fundidora y Afinadora, Monterey, Mexico, 1907-8; Chief Chemist, Cia. Metalurgica de Torreon, Torreon Coahuila, Mexico, 1909—.

SAMUEL JAMES GORMLEY. West Jordan, Utah.

Student, 1895-6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895-6; Assistant Assayer, Anaconda Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist to same company, 1900-2; Superintendent of Sampling Works, Washoe Smelting Company, Anaconda, Montana, 1902-6; Smelter Superintendent, Bingham Copper and Gold Mining Company, West Jordan, Utah, 1906.

RUE N. HINES. Mocorito, Sinaloa, Mexico.

(B. S., New Mexico School of Mines, 1907.)

Student, 1904-7. From Socorro, New Mexico. Superintendent, West Coast Mining and Smelting Company, Mocorito, Sinaloa, Mexico, 1907-1909.

EDMUND NORRIS HOBART. Clifton, Arizona.

Student, 1906-8, 1909-10. From Clifton, Arizona. Chemist, Socorro Mines Company, Mogollon, New Mexico, 1909.

ANTON HOGWALL. Nogal, New Mexico.

Student, 1898-9. From White Oaks, New Mexico. Assayer, Buckeye Mining Company, Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Company, and Helen Rae Mining Company, White Oaks, New Mexico, 1901; Assayer, American Gold Mining Company, Nogal, New Mexico, 1902.

CARL JOHN HOMME. Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate Student. 1899-1900. From Wittenburg, Wisconsin. Assayer and Chemist to Candelaria Mining Company, El Paso, Texas, 1900-01; Assistant Superintendent, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902.

WILLIAMS ELIAS HOMME. Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate Student, 1902-03. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. HOWELL. Tehuacan, Puebla, Mexico.

Student, 1900-1905. From Socorro, New Mexico. Civil Engineer on railway from Acapulco, Mexico, 1906-7; Civil Engineer, Mexican Central R. R., 1907—.

HARRY J. HUBBARD. Jocoro, San Salvador, Central America.

(B. S., New Mexico School of Mines, 1906.)

Student, 1905-6. From Bisbee, Arizona. Mine-foreman, Navidad Mine of Greene Gold-Silver Company, Concheno, Chihuahua, Mexico, 1906; Chemist, Navidad Mine of Greene Gold-Silver Company, 1906; Assistant Mill Superintendent, Sahuauycan Mining Company Sahuauycan, Chihuahua, Mexico, 1906; Machine Drill Foreman, Sirena Mine, Guanajuato, Mexico, 1907; Shift-boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan and Associates, in southern states of Mexico, 1907; Tramway Superintendent, Minas Bonanzas y Anexas, Bonanza, Zac., Mexico, 1908; Mine-foreman, Butters Divisavero Mines, Jocoro, San Salvador, Central America, 1909—.

JOHN AUGUST HUNTER. Congress, Arizona.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-4; Chemist and Metallurgist, American Smelting and Refining Company, Aguas Calientes, Mexico, 1904-8; Metallurgist, Congress Mining Company, Congress, Arizona, 1909—.

CHARLES THAYER LINCOLN. Brooklyn, New York.

(S. B., Massachusetts Institute of Technology, 1901.)

Graduate Student, 1902-3. From Boston, Massachusetts. Chemist to American Bell Telephone Company, Boston, Massachusetts, 1901-2; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-3; Acting Professor, same, 1903-4; Instructor in Chemistry, Iowa State University, Iowa City, 1904-5; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-7; Chemist, Arbuckles Brothers Sugar Refinery, Brooklyn, New York, 1907—.

FRANCIS CHURCH LINCOLN. Butte, Montana.

(S. B., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1902.)

Assayer to San Bernardo Mining and Milling Company, 1900; Chemist to Butterfly Terrible Gold Mining Company, 1900-1; Professor of Metallurgy, 1902-4; Assistant Superintendent, Ruby Gold and Copper Company, Ortiz, State of Sonora, Mexico, 1904; General Manager, Arizona Gold and Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907—.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer with Illinois Steel Company, 1900.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University; M. D., Bellevue Hospital.)

Graduate Student, 1900-1. From New York City; 136 Fifth Avenue, New York City, 1901.

DANIEL M. MILLER. Lake Valley.

(B. S., New Mexico School of Mines, 1909.)

Student, 1906-9. From Lake Valley, New Mexico.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899-1900. From Santa Ana, California, County Surveyor, Orange County, California, 1900-1. Assistant Engineer, Temescal Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Company, 1901-2; Assistant Engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

ERLE D. MORTON. Luning, Nevada.

(E. M. in Geology, New Mexico School of Mines, 1909.)

Student, 1903-5, 1908-9. From Los Angeles, California. Assistant Superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-6; Washington University, 1906-7; Mine Examiner, Los Angeles, California, 1907-8; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908; Mine Superintendent, Arizona and Nevada Copper Company, Luning, Nevada, 1909—.

WILLIAM FREDERICK MURRAY. Hastings, Colorado.

Student, 1904-6. From Raton, New Mexico. In Chief Engineer's Office of the Victor Coal Company, Denver, 1906-7; Assistant Engineer, Victor Fuel Company, 1907-8; Assistant to Chief and Traveling Engineer, Victor Fuel Company, and Colorado and South-Eastern Railway Company, 1908; Assistant Superintendent, Hastings Mine, Victor Fuel Company, Hastings, Colorado, 1909—.

PATRICK J. O'CARROL.*

(B. A., University of Dublin, Ireland.)
Graduate Student, 1898-9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896; Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

JUAN PALISSO. Mexico.

Student, 1903-4. From Barcelona, Spain. Mining Engineer, Mexico.

ORESTE PERAGALLO. El Paso, Texas.

(E. M., New Mexico School of Mines, 1908.)
Student, 1907-8. From Ciudad Juarez, Chihuahua, Mexico. Mining Engineer, El Paso, Texas, 1908.

FOUNT RAY. Italy, Texas.

Student, 1901-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Company, Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902.

ALBERT BRONSON RICHMOND. Tucson, Arizona.

Student, 1900-1. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gairlon, Sonora, Mexico, 1901-2; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and Metallurgist, Patagonia, Arizona; General Manager, Mansfield Mining and Smelting Company, Safford, Arizona, 1908; Consulting Engineer, Tucson, Arizona, 1909—.

DELL FRANK RIDDELL. Parral, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; M. E., New Mexico School of Mines, 1905.)
Graduate Student, 1903-5. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4; Acting Professor of Assaying, same, 1904-5; Holder of Allis-Chalmers Scholarship, 1905-6; Engineer Universam Pump and Manufacturing Company, Kansas City, Missouri, 1906-7; Superintendent, Benito Juarez Mine, Parral, Chihuahua, Mexico, 1907-8; Consulting Engineer and Acting Superintendent, Providentia Mines Company, Parral, Chihuahua, Mexico, 1908.

ORLANDO DOUGLAS ROBBINS. Santa Rita.

(E. M., New Mexico School of Mines, 1909.)
Student, 1905-9. From Louisville, Kentucky. Chemist, Santa Rita Mining Company, Santa Rita, New Mexico, 1909—.

WILLIAM CARLOS STEVENSON.* Redlands, California.

Student, 1900-1. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1903-4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1902.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

(B. S., in Chemistry and Metallurgy, New Mexico School of Mines, 1896)
Student, 1895-6. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate Student, Johns Hopkins University, 1897-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1903-4. From Peoria, Illinois. Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Bellingham, Washington.

(B. S., M. S., University of Illinois; LL. B., University of Michigan; A. M., Ph. D., Columbia University.)
Graduate Student, 1901-2. Mining Lawyer, Bellingham, Washington.

OLIVER RUSSELL SMITH. Zillah, Washington.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1898; C. E., New Mexico School of Mines, 1903.)
Graduate Student, 1899-1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1; Instructor in Engineering and Drawing, New Mexico School of Mines, 1901-2; Assistant Professor in Engineering and Drawing, New Mexico School of Mines, 1902; Assistant Survey, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902; Deputy Mineral Surveyor, U. S. Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1902-7; Civil Engineer, Santa Fe R. R., San Bernardino, California, 1907-8; Engineer, United States Reclamation Service, Zillah, Washington, 1908—.

OTTO JOSEPH TUSCHKA. Monterey, Mexico.

(E. M., in Metallurgy, New Mexico School of Mines, 1897.)
Student, 1893-7. Assayer and Chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-8; Graduate Student, New Mexico School

* Deceased.

of Mines, 1898-9; Assistant Sampling Mill Foreman and Chemist, Guggenheim Smelting and Refining Company, Monterey and Aguas Calientes, Mexico, 1899-1900; Assayer, Seaman Assay Laboratory, El Paso, Texas, 1900; Chief Chemist, Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

MILTON BENHAM WESTCOTT. Monterey, Mexico.

Student, 1904-5. From Chicago. Engineering Corps, Santa Fe Railroad, 1905; Assistant County Surveyor, El Paso County, 1906-7; Assistant Engineer, Monterey Railway, Light and Power Company, Monterey, Mexico, 1907; Assistant Engineer, Monterey Waterworks and Sewer Company, 1907-8; Resident Engineer, Monterey Water Works and Sewer Company, 1908.

PATRICK ANDREW WICKHAM. Ray, Arizona.

Student, 1893-4. From Socorro, New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Company, and Albemarle Mining Company, Bland, New Mexico, 1898-9; Mechanical Engineer, Mt. Beauty Mining Company, Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Company, Cripple Creek, Colorado, 1900-1; Foreman, Guggenheim Exploration Company, Minas Tecolotes, Santa Barbara, Mexico, 1901-2; Foreman, Independence Consolidated Gold Mining Company, Cripple Creek, Colorado, 1902-4; Manager, Consuelo and Esperanza Gold Mining Companies, Dolores, Mexico, 1904-6; Assistant Superintendent, Kelvin-Calumet Copper Mining Company, Ray, Arizona, 1907-9; Superintendent, La Cienega Mining Company, Maris, Chihuahua, Mexico, 1909—.

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.

Student, 1893-4. From Council Bluffs, Iowa. Assistant Superintendent and Metallurgist, Granby Consolidated Mining, Smelting and Power Company, Limited, Grand Forks, B. C., 1898; at present Superintendent of the same.

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REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

1910 -- 1911

SOCORRO, N. M.

MAIN BUILDING

ANNUAL REGISTER

OF THE

NEW MEXICO
SCHOOL OF MINES

SOCORRO, N. M.

1910 -- 1911

WITH ANNOUNCEMENTS FOR 1911-12

SANTA FE, N. M.
NEW MEXICAN PRINTING COMPANY
1911.

CALENDAR.

1911-1912.

First Semester:

September 11, Monday—Registration of students.
November 30 and December 1, Thursday and Friday—Thanksgiving recess.
December 22, Friday—Christmas vacation begins.
January 8, Monday—Work resumed.
January 15-18, Monday to Thursday—Examinations.

Second Semester:

January 19, Friday—Registration of students.
February 22, Thursday—Washington's birthday.
May 13-16, Monday to Thursday—Examinations.
May 17, Friday—Commencement.

BOARD OF TRUSTEES.

OFFICERS OF THE BOARD.

FACULTY.

EMMET ADDIS DRAKE..................*President of the Faculty.*
A. B., Wisconsin University, 1882; A. M., 1887.

EDGAR G. TUTTLE,...........*Professor of Mining and Metallurgy.*
E. M., School of Mines, Columbia University.

LON CAIN WALKER,...................*Professor of Mathematics.*
Ph. B., Ohio University, 1893; A. B., Leland Stanford Junior University, 1900; A. M., 1902.

GEORGE IRVING KEMMERER,.............*Professor of Chemistry.*
A. B., Wisconsin University, 1904; A. M., 1906; Ph. D., University of Pennsylvania, 1908.

FREDERICK PARNELL PAUL, *Professor of Geology and Mineralogy.*
Ph. D., University of Heidelberg, 1906; Assoc. B. S. M., 1898.

BYRON KEMP COGHLAN,...........*Professor of Civil Engineering.*
B. S., University of Illinois, 1908.

JOHN FERDINAND BARKLEY,...........*Instructor in Engineering.*
B. S. and E. M., Michigan College of Mines, 1910.

CARL CLYDE SMITH,.................*Principal of the Academy.*
Ph. B., Ohio University, 1890.

ANNE W. FITCH, ...*Registrar.*

NEW MEXICO SCHOOL OF MINES.

HISTORICAL SKETCH.

The New Mexico School of Mines was founded by act of the Legislature of 1889. The act provided for the support of the School by an annual tax of one-fifth of a mill on all taxable property.

Under an act of the Legislature, approved February 28, 1891, a board of trustees was appointed. Organization was effected and immediate steps were taken towards the erection of necessary buildings. In this same year a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892 a circular of information regarding the New Mexico School of Mines at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land fifty thousand acres for its support and maintenance. From this source of revenue the School has already received more than $17,000.

In 1899 the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901 the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grant of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903 the Thirty-fifth General Assembly raised the millage to forty-five hundedths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

Since 1903 the appropriation for the support and maintenance of the School of Mines has been increased at each session of the General Assembly. At the last session the appropriation was raised to $19,000 a year.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and 10 of this act. Said trustees and their successors in office shall consitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said school require it.

The board of trustees shall require such compensation for all

assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico School of Mines is located at Socorro, the county seat of Socorro county, on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the valley of the Rio Grande at the foot of the Socorro range of mountains at an elevation of 4,600 feet above the level of the sea. The surrounding scenery is diversified by plains, valleys, mesas, hills, and mountains. The climate of the locality is pre-eminently pleasant and healthful, and has long attracted health-seekers who would escape the rigors of less favored localities. The air is exceedingly dry and the temperature is mild and equable. Socorro's public water supply comes from warm springs that issue from Socorro mountain three miles away. The water is famed for its purity and has always been an attraction to visitors and residents.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Deming, Fierro, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-

dressing, concentrating, smelting, lixiviation, cyaniding, and other metallurgical processes.

A number of mines of various kinds, smelters, irrigating systems, and other engineering works are accessible to the School. Within a few hours' ride by rail are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years they have yielded their wealth to the European and centuries before his advent gave up even greater treasures to the native races.

The history of modern mining schools shows that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of the world.

The School is a territorial institution. It was established primarily to promote the development of the mineral resources of New Mexico and to provide facilities for the young men of the territory to secure a practical education in all departments of mining. Naturally, however, the institution's field of usefulness has steadily grown broader. Not only New Mexico but also other parts of the southwest have felt its influence through its graduates in the development of the mining industries of this great region. Moreover, a considerable number of students from other parts of the country who desired to avail themselves of the peculiar advantages of this region have come to the School of Mines for the training they needed and the number of such young men is constantly increasing.

During the entire period of his training the fact is impressed upon the mind of the student that intelligent mining is a business operation capable of being put on as secure a foundation as any other, that from beginning to end it is akin to all other great business undertakings, that while lucky finds will doubtless continue to be made mining is no longer to be considered a mere lottery appealing to the gambling propensities.

During the past quarter of a century the development of the mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surroundings of the School already described create an invigorating mining atmosphere which is entirely wanting in situations remote from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in those technical institutions of learning where all practical branches are equally represented, singleness of purpose is a leading feature of the New Mexico School of Mines. The conservation of energy growing out of the special method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect under the direct supervision of his instructors various plants and works and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the territory has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made under government auspices to investigate closely the geological structure of New Mexico mountains such as has been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican

mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

Much of the advanced professional work of the School is of an original nature to the end that the graduates may be skilled, theoretically and practically, in the very problems which they as professional men will be called upon to solve. This work is carried on by the advanced students under the direction of the professors and involves the collection of notes, sketches, maps, and specimens, and the results of directed observation in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining and in the reduction of the ores of lead, silver, gold, and copper are so numerous that it is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply, and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigations of the ores of iron, manganese, aluminum, cobalt, nickel, tin, and quicksilver, together with the beds of coal, salt, alums, building stones, mineral-paints, cement-rocks, marls, etc., are directly in line with the advanced laboratory work of the School, and every student who undertakes such work is encouraged in every way possible to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the Territory with the concurrence of the Council for a term of four years. The Board of Trustees elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them.

By act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of the territory. The New Mexico School of Mines, therefore, is composed of the College and the Academy.

THE COLLEGE.

The Requirements for Admission.

Candidates for admission to the College are required to present a statement from some school of recognized standing certifying that they have completed and received a passing grade in the

following subjects: Arithmetic, Elementary Algebra, Plane and Solid Geometry, ninth and tenth grade English, and one year of Elementary Physics. Those candidates who are unable to present such a statement may take an examination by the Principal of the Academy on any of the foregoing subjects to determine their proficiency therein.

Registration.

No student will be permitted to register for any subject until the pre-requisites are credited to him on the school records. Therefore the student is advised not to delay either in making up any deficiencies which may exist or in obtaining from the School the credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided, that no more than the first two years of the curriculum be thus credited to a student who has not yet received the bachelor's degree, and provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the engineer's degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time of matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the school may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students desiring to take special courses without a view to graduation may do so provided that they give evidence of proficiency in the prerequisite subjects and that their taking such courses does not interfere with the regular schedule of classes.

Curricula.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

Mining Engineering.

Metallurgical Engineering.

Mining Geology.

Civil Engineering.

Each curriculum covers four years. Upon the satisfactory completion of either of them, the Bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines who have spent two years in professional work, at least one of which must have been in a position of responsibility, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours' work in the field or in the laboratory. In the following outlined statement of curricula the number of hours per week required in the class-room and in the field or in the laboratory are given separately. The number of hours required in the field or in the laboratory represents *average* time, however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

UNIFORM CURRICULUM FOR THE FIRST YEAR.

The curriculum for the first year of the four courses offered at the School of Mines is the same in all respects. This arrangement is of advantage to the student, for it gives him until the beginning of the second year to determine for which of the four courses he is best fitted by inclination or aptitude.

Mathematics, physics, and chemistry are fundamental subjects for the successful engineer. For that reason the first year of all the engineering courses is devoted to a thorough grounding in those three subjects, as will be seen in the tabular statement below. Specialization does not begin until afterwards.

Excellent facilities are offered for the acquisition of a thorough knowledge of these subjects so necessary to successful engineering work both during the remainder of the course and during a professional career. The physical laboratory is well equipped with such apparatus as present-day requirements demand, and the chemical laboratories are fitted up in a manner that leaves little to be desired for comfort, convenience, or efficient work.

Course Numbers.		Courses.	HOURS PER WEEK.	
			Class.	Lab'y.
		First Semester.		
I.	1.	Advanced Algebra	3	
I.	2.	Trigonometry	5	
I.	3.	Analytic Geometry	2	
III.	1.	General Chemistry	6	6
IV.	1.	Mechanical Drawing and Lettering		
IV.	10.	Kinematics and Machines	2	
		Second Semester.		
I.	1.	Advanced Algebra	3	
I.	3.	Analytic Geometry	5	
III.	2.	Qualitative Analysis	1	9
IV.	2.	Mechanical Drawing and Lettering		6
IV.	3.	Descriptive Geometry	3	
IV.	4.	General Surveying	3	4

MINING ENGINEERING.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valueing property, properly reporting propositions submitted for investment, calculating the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaptation of the steam shovel and stripping methods to western metal mines are treated at considerable length in the course on Mining Methods.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives detailed consideration.

FIRST YEAR.

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SECOND YEAR.

Course Numbers.		Courses.	Hours per week. Class.	Lab'y.
		First Semester.		
I.	4.	Calculus	5	
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
IV.	9.	General Physics I	3	3
V.	I.	Mineralogy	3	3
		Second Semester.		
I.	5.	Calculus	5	
III.	4.	Ore Analysis	1	9
III.	15.	General Physics II	3	3
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	3	3

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
II.	1.	Mechanics	4	
II.	2.	Strength of Materials	3	
III.	5.	Fuel Analysis		3
IV.	11.	Power and Power Transmission	3	
V.	4.	Geological Mapping	1	4
V.	7.	Petrology	2	3
VI.	1.	Mining A	4	
		Second Semester.		
II.	1.	Mechanics	4	
II.	2.	Strength of Materials	3	
IV.	12.	Machine Design	2	6
V.	7.	Petrology	2	3
VI.	2.	Mining B	4	
VII.	1.	Fire Assaying	1	8
VII.	2.	Metallurgy	3	

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
II.	3.	Hydraulics	5	
IV.	22.	Mine Constructions		12
V.	5.	Economic Geology A	3	3
VI.	4.	Ore Dressing	3	
VI.	5.	Mine Plant	3	
VI.	6.	Design of Mine Plant		3
VII.	5.	Metullurgy of Copper	2	
		Second Semester.		
IV.	22.	Mine Constructions	3	9
V.	5, 6.	Economic Geology, A and B	3	3
VI.	4.	Ore Dressing	2	
VI.	5.	Mine Plant	3	
VI.	6.	Design of Mine Plant		3
VI.	7.	Mine Administration and Accounts	2	
VI.	8.	Examination of Mines	1	6

METALLURGICAL ENGINEERING.

The aim of this four years course is to train the student for a professional career in any branch of metallurgical work. Attention is given during the first two years to such fundamental subjects as mathematics, chemistry, physics, geology, mineralogy and preliminary courses in engineering. Instruction in metallurgy proper begins in the third year, both lectures and laboratory experiments being employed for the purpose. Chemistry and geology are provided for, also. The work of the fourth year is along the line of advanced courses in metallurgy, especial attention being given to laboratory experiments, high temperature conditions of metallurgy, training in execution, and interpretation of results. Such higher branches of engineering, chemistry, and courses of importance in mining engineering claim a considerable share of attention.

The course has been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals.

FIRST YEAR.

See Page 14.

SECOND YEAR.

Course Numbers.		Courses.	HOURS PER WEEK. Class.	Lab'y.
		First Semester.		
I.	4.	Calculus	5	
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
IV.	9.	General Physics I	3	3
V.	1.	Mineralogy	3	3
		Second Semester.		
I.	5.	Calculus	5	
III.	4.	Ore Analysis	1	9
III.	15.	General Physics II	3	3
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	3	3

THIRD YEAR.

Course Numbers.		Courses.	HOURS PER WEEK. Class.	Lab'y.
		First Semester.		
II.	1.	Mechanics	4	
II.	2.	Strength of Materials	3	
III.	5.	Fuel Analysis		3
III.	7.	Advanced Quantitative Analysis		6
III.	8.	Electro-Analysis	1	6
IV.	11.	Power and Power Transmission	3	
V.	5.	Economic Geology A	3	3
VI.	1.	Mining A	4	
		Second Semester.		
II.	1.	Mechanics	4	
II.	2.	Strength of Materials	3	
V.	5, 6.	Economic Geology A and B	3	
IV.	12.	Machine Design	2	6
VII.	1.	Fire Assaying	1	8
VII.	2.	Metallurgy	3	
VII.	3.	Furnaces	3	

FOURTH YEAR.

Course Numbers.		Courses.	HOURS PER WEEK. Class.	Lab'y.
		First Semester.		
II.	3.	Hydraulics	5	
III.	13.	Electro-Metallurgy	2	
IV.	22.	Mine Constructions		12
VI.	4.	Ore Dressing	3	
VII.	4.	Metallurgy of Lead	3	
VII.	5.	Metallurgy of Copper	2	
VII.	9.	Metallurgical Plant	1	
VII.	9.	Metallurgical Design		3
		Second Semester.		
IV.	22.	Mine Constructions	3	9
VI.	4.	Ore Dressing	2	
VI.	7.	Mine Administration and Accounts	2	
VII.	6.	Metallurgy of Gold and Silver	5	
VII.	7.	Metallurgy of Iron and Steel	4	
VII.	9.	Metallurgical Design		6

MINING GEOLOGY.

This course extending over a period of four years is intended primarily to train men to examine, report and direct the future development of mines. In the first two years the course prescribed is similar to that of the Mining Engineering Department, so that students have a thorough training in fundamental subjects, especially in mathematics, chemistry, surveying, and other preliminary courses in engineering. In the third year the attention of the student is directed largely to geological subjects related closely to mining, namely topographical surveying, geological surveying, petrology, and economic geology, while still continuing his studies in chemistry, mining, metallurgy, etc. The fourth year is devoted largely to advanced work in mining geology, visiting and reporting in detail on geological problems connected with ore deposition in various mining fields. Attention also is paid to the geological occurrence of petroleum.

FIRST YEAR.

See Page 14.

SECOND YEAR.

Course Numbers.		Courses.	HOURS PER WEEK.	
			Class	Lab'y.
		First Semester.		
I.	4.	Calculus	5	
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
IV.	9.	General Physics I	3	3
V.	1.	Mineralogy	3	3
		Second Semester.		
I.	5.	Calculus	5	
III.	4.	Ore Analysis	1	9
III.	15.	General Physics II	3	3
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	3	3

THIRD YEAR.

Course Numbers.		Courses.	HOURS PER WEEK. Class.	Lab'y.
		First Semester.		
III.	7.	Advanced Quantitative Analysis	1	6
V.	3.	Historical Geology	3	
V.	4.	Geological Mapping	1	8
V.	5.	Economic Geology A	3	3
V.	7.	Petrology	2	6
VI.	1.	Mining A	4	
		Second Semester.		
III.	7.	Advanced Quantitative Analysis		6
V.	4.	Geological Mapping	1	4
V.	5, 6.	Economic Geology A and B	3	3
V.	7.	Petrology	2	6
VI.	2.	Mining B	4	
VII.	1.	Fire Assaying	1	8
VII.	2.	Metallurgy	3	

FOURTH YEAR.

Course Numbers.		Courses.	HOURS PER WEEK. Class.	Lab'y.
		First Semester.		
V.	8.	Geological Surveying A	1	8
V.	10.	Ore Deposits A	2	
V.	12.	Paleontology	3	3
V.	13.	Abstracts	3	
V.	14.	Special Problem		5.
VI.	4.	Ore Dressing	4	
VI.	5.	Mine Plant	3	
VI.	6.	Design of Mine Plant		3
		Second Semester.		
V.	9.	Geological Surveying B	1	8
V.	11.	Ore Deposits B	2	
V.	14.	Special Problem		5
V.	15.	Valuation of Ore Deposits	2	6
VI.	5.	Mine Plant	3	
VI.	6.	Design of Mine Plant		3
VI.	7.	Mine Administration and Accounts	2	
VI.	8.	Examination of Mines	1	8

CIVIL ENGINEERING.

This department provides a course of study in the theory anc application of the principles of civil engineering. The first tw years of work are substantially the same as in the other engineer ing courses, including practical work in drafting room and field as well as instruction in the fundamental principles of mathema tics and physics. In the third year the studies relate more directl to civil engineering. Technical courses cover the principles of struc tural and machine design, power and power transmission, and othe fundamental engineering processes. In the drafting room the studen applies those principles to the design of machines, and bridge an roof trusses. Sufficient field work is given to make the studen thoroughly familiar with surveying instruments, and their us in road, mine, and railroad surveys.

FIRST YEAR.

See Page 14.

SECOND YEAR.

Course Numbers.		Courses.	HOURS PER WEE	
			Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
IV.	9.	General Physics I	3	3
V.	1.	Mineralogy	3	3
		Second Semester.		
I.	5.	Calculus	5	
III.	4.	Ore Analysis	1	9
III.	15.	General Physics II	3	3
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	3	3

THIRD YEAR.

Course Numbers.		Courses.	HOURS PER WEEK.	
			Class.	Lab'y.
		First Semester.		
II.	1.	Mechanics	4	
II.	2.	Strength of Materials	3	
IV.	7.	Railway Location	3	8
IV.	11.	Power and Power Transmission	3	
IV.	8.	Roads and Pavements	3	
		Second Semester.		
II.	1.	Mechanics	4	
II	2.	Strength of Materials	3	
III.	7.	Advanced Qnantitative Analysis		6
IV.	12.	Machine Design	2	6
IV.	13.	Graphics	2	6
IV.	14.	Railroad Track, Yard, and Structures	4	

FOURTH YEAR.

Course Numbers.		Courses.	HOURS PER WEEK.	
			Class.	Lab'y.
		First Semester.		
II.	3.	Hydraulics	5	
III.	5, 6.	Water and Fuel Analysis		6
IV.	15.	Stresses	3	
IV.	16.	Structural Details		9
IV.	17.	Water Supply Engineering	5	
IV.	18.	Masonry	5	
		Second Semester.		
IV.	19.	Contracts and Specifications	2	
IV.	20.	Sewerage and Drainage	5	
IV.	15.	Stresses	3	
IV.	16.	Structural Details		9
IV.	21.	Concrete Structures	3	6

DEPARTMENTS OF INSTRUCTION.

I. DEPARTMENT OF MATHEMATICS.

PROFESSOR WALKER.

The study of mathematics is emphasized as a necessary basis for the further instruction in the engineering subjects. The courses have been arranged to meet the extensive needs of students in the various branches of engineering, and are treated so as to give the student both logical training and power of application. The aim is to make these courses practical in the sense of furnishing thorough drill on fundamental principles and much practice in their application. Emphasis is laid upon accuracy and system in the solution of numerical problems. Students whose training in arithmetical work has been deficient, or who are otherwise inadequately prepared, or who lack aptitude for mathematical study, cannot pursue these courses successfully.

1. Advanced Algebra.

The work begins with a review of Elementary Algebra, intended to test the student's familiarity with fundamental principles and operations, those showing deficient preparation not being permitted to continue. This review is followed by more advanced work in algebra, but emphasis is laid on the thorough mastery of the ordinary rules rather than of covering a large amount of ground.

Prerequisites: Elementary Algebra.
Time: Class-room, three hours a week, one year.
Text: Hawkes, *Advanced Algebra.*

2. Trigonometry.

Definitions and relations of the six trigonometric functions as ratios; circular measure of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines, or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. The solution of right and oblique

triangles involving logarithmic calculation with tables. The course is fully illustrated by practical problems.

An elementary treatment of spherical trigonometry is included.

Prerequisites: Elementary Algebra and Plane and Solid Geometry.

Time: Class-room, five hours a week, first semester.

Text: Granville, *Plane and Spherical Trigonometry and Tables.*

3. Analytic Geometry.

Introduction to algebraic geometry, dealing with such topics as co-ordinate systems, transformations, loci and their equations, the straight line, circle, parabola, ellipse, hyperbola, the geometric interpolation of the general equation of second degree, and the elements of three-dimensional geometry.

Prerequisites: Courses 1 and 2 of this department must either precede this course or to be taken at the same time.

Time: Class-room, two hours a week, first semester and five hours a week, second semester.

Text: Smith and Gale, *Introduction to Analytic Geometry.*

4. Differential Calculus.

This course includes limits, differentiation, curve tracing and other applications of the derivative, maxima and minima, rates, curvature, evolutes, involutes, series, and partial differentiation.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, five hours a week, first semester.

Text: Granville, *Elements of the Differential and Integral Calculus.*

5. Integral Calculus.

The topics studied are integration, applications to areas, volumes, rectification of curves, moments of area and inertia, and multiple integrals. Throughout the course special attention is given to the solution of problems and applications to geometry, physics, mechanics, and engineering, which are introduced as soon as the requisite theory has been developed.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Time: Class-room, five hours a week, second semester.

Text: Granville, *Elements of the Differential and Integral Calculus.*

Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work. The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in

mathematical investigation of problems of engineering or applied science. The idea that an engineer should be a practical rather than a theoretical mathematician guided the selection of elective and graduate courses. Students who wish to take optional work should arrange at the beginning of the college year with the head of the department of mathematics.

In addition to the foregoing, which are required of all students of engineering, the following elective and graduate courses are offered:

6. Integrals of Mechanics.

Certain types of integrals which are met with great frequency in the study of mechanics, are treated. Those integrals, namely, the inertia integrals, those defining mass, and moment and center of mass, are essential in the discussion of the motion and the conditions of equilibrium of systems of particles, and rigid bodies. Other integrals are studied, mechanics applications to work, attraction, pressure, and centers of gravity and pressure.

Text: Lester, *The Integrals of Mechanics.*

7. Applications of the Calculus to Mechanics.

Wherever the teaching of mathematics to engineering students is discussed, and frequently in cases of other classes of students, the criticism which is almost without exception the most insistent is this: that the student leaves the course without adequate ability to *apply* his mathematical knowledge. This means that he has not the faculty of taking a problem, giving it an analytic formulation, and interpreting the analytic results. This course is to supply the needed training. Students should obtain a comprehensive view of this course, partly because of the value of such a course as a means of general mental development, partly because new practical applications of discoveries in Engineering are continually being made, and no one can predict what particular facts or principles are most likely to find important practical applications in the future.

Text: Hedrick & Kellogg, *Applications of the Calculus to Mechanics.*

8. Differential Equations.

In many Colleges of Engineering, the need is felt for a course treating the subject of Differential Equations, limited in scope yet comprehensive enough to furnish the student of engineering with sufficient inforamtion to enable him to deal intelligently with any differential equation which he is likely to encounter. To meet this need is the object of this course. This course will be found

to be complete in all those portions which bear upon practical applications. Numerous applications to problems in Geometry, Physical Sciences, and Engineering are introduced.

Text: Cohen, *An Elementary Treatise on Differential Equations.*

II. DEPARTMENT OF THEORETICAL AND APPLIED MECHANICS.

PROFESSOR WALKER.

The instruction in Applied Mechanics is given in the third and fourth years. The fundamental principles of Statics, Dynamics, Strength of Materials, and Hydraulics are developed in an extended series of lectures and recitations, accompanied by blackboard work and written exercises. Particular attention is given to the solution of problems which involve the application of these principles in engineering practice and test the student's ability to apply what he has learned, and to perform intelligently the calculations needed, whatever mathematics they may involve, up to and including the Differential and Integral Calculus. Especial stress is laid on another matter of very great importance to the student which is the cultivation of neatness and accuracy and the systematic arrangement of his work.

1. Mechanics.

This course deals with the fundamentals of mechanics and serves as an introduction to the courses in strength of materials, hydraulics, and astronomy. Centers of gravity and radii of gyration, kinematics and kinetics of a material particle, and dynamics of a rigid body are included. Special attention is paid to the solution of problems under the general divisions of force, work, and motion. The problems chosen are of a practical nature, and are intended to develop the power of analysis together with accuracy and rapidity of calculation.

Prerequisites: Courses 4 and 5 of Department I must precede or accompany.

Time: Class-room, four hours a week, one year.

Texts: Smith & Longley, *Theoretical Mechanics.*
Sanborn, *Mechanics Problems.*

2. Strength of Materials.

A study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to torsion, to compression, and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moment, slopes, and deflection; overhanging, fixed, and continuous beams, reinforced concrete columns and beams, flat plates,

and thick cylinders; stresses in hooks, in columns and in beams subjected to tension and compression as well as bending; torsional stresses; and stresses in springs.

Prerequisites: Course 1 of this department must accompany or precede.

Time: Class-room, three hours, one year.

Texts: Slocum & Hancock, *Strength of Materials.*
Shepard, *Problems in Strength of Materials.*

3. Hydaulics.

Under this head are treated fluid pressure, the principles of fluid equilibrium, and the laws governing the flow of water through orifices, over weirs, in closed conduits, and in open channels. The hydraulic laws relating to turbines and centrifugal pumps are briefly discussed, showing to what extent theory applies to these subjects.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, five hours a week, first semester.

Text:

In addition to the above subjects, which are required in the engineering courses, opportunity for further elective work is given.

III. DEPARTMENT OF CHEMISTRY.

Dr. Kemmerer,

C. J. Neel, Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

It is the intention to secure as perfect a correlation as possible between the lectures, the quizzes, and the laboratory-work, in order that the greatest efficiency in instruction may be attained.

1. Elements of Chemistry.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common elements.

The class-room work consists of lectures in which the chemistry of the elements and their compounds is simplified as much as possible. The more important reactions and theories are illustrated with lecture-table experiments and immediately following the class-room work each student performs as many experiments as possible in the laboratory, carefully recording the results. These records are then corrected by the instructor and returned to the student. Once each week the students are quizzed on both the class-room and laboratory work and once each month the work is reviewed in a written test.

Time: Class-room, six hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Newth, *Inorganic Chemistry.*
V. Leneher, *Laboratory Experiments in General Chemistry.*

2. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper groups are analyzed. In this manner are studied the metals of all the groups and finally the acids. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze several of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisite: Course 1 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. I.*
Baskerville & Curtman, *Qualitative Analysis.*

3. Quantitative Analysis.

A course embodying the general principles of quantitative anlysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

The gravimetric determination of chlorine in a soluble chloride; water of crystallization in copper sulphate; iron and sulphur in ferrous or ferric sulphate; carbon dioxide, calcium, and magnesium in dolomite; silver and copper in a dime; tin, lead, copper, and zinc in a bronze; and silica in an insoluble silicate.

The class-room work consists in lectures on the use and care of balances, crucibles and desiccators, on the selection and use of indicators, on the use, care, and calibration of volumetric flasks, burettes and pipettes, on the methods used in the laboratory from the standpoint of modern chemical theories, in quizzes on these topics, and in the solution of stoichiometric problems involving calculations which are similar to those arising from, and essential to, the laboratory experiments.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. II.*
Fresenius, *Quantitative Chemical Analysis.*

4. Ore Analysis.

A thoroughly practical course in the determining of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products.

Each student is required to analyze two or more ores for each of the following: Iron, copper, zinc, lead, phosphorus, calcium, manganese, and silica.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Texts: Low, *Technical Methods of Ore Analysis.*
Sutton: *Volumetric Analysis.*

5. Fuel Analysis.

Analyses of various coals or of other fuels are made and their heat-values are then calculated from these analyses and also determined experimentally by means of the calorimeter. Flue-gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

6. Water Analysis.

Analyses of waters are made in regard to their possible use in boilers. These analyses involve determinations of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 4 of this department.

Time: Laboratory, last ten weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Fresenius, *Quantitative Chemical Analysis.*

7. Advanced Quantitative Analysis.

This course is a continuation of Course 3 or 4. It may be substituted for Course 8. The work will be chosen to suit the needs of each student. It may consist of the complete analysis of rocks and minerals, advanced ore analysis, iron and steel analysis, cement analysis, or the determination of some of the rare elements.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, one semester.

8. Electro-Analysis.

This course will deal with the practical application of the electric current for determining some of the common metals such as copper, silver, lead, and zinc. After the student has become familiar with the methods used for determining each of these, he will use the current in separating mixtures of metals and as a rapid, accurate method of ore analysis.

The course may be substituted for Advanced Quantitative Analysis, Water and Fuel Analysis, or taken as a special.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, one semester.

Text: Edgar F. Smith, *Electro Analysis.*

9. Inorganic Preparations. (Special.)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 2 of this department.

Time: Class-room, one hour a week, one semester.
Laboratory, six hours a week, one semester.

10. Industrial Inorganic Chemistry. (Special.)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of

any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one semester.
Text: Thorp, *Outlines of Industrial Chemistry.*

11. Organic Chemistry. (Special.)

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.
Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

2. Physical and Theoretical Chemistry. (Special.)

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, one semester.
Texts: Ewell, *Physical Chemistry.*
Jones, *Elements of Physical Chemistry.*

Electro-Metallurgy.

The course is designed to furnish the student of metallurgy with a knowledge of the theoretical principle and practical application of the electric current as used in the extraction, production, and purification of metals and chemical compounds. Both electro-thermal and electrolytic processes will be studied.
Prerequisite: Course 2 of Department VII.

Elements of Practical Photography. (Special.)

The course is planned to furnish the engineer with a working knowledge of photography such as will enable him to use the camera intelligently as an aid in his engineering work.

The class-room work will consist of one lecture a week which will be supplemented by laboratory work in which each student will be required to take and finish a good negative, velox print, platinum print ,lantern slide, and bromide enlargement.

Time: Class-room, one hour a week, second semester.

15. General Physics II. (Elements of Electricity.)

This course deals with the elementary principles of electricity, magnetism, and the practical application of the same in dynamos, motors, lamps, and electric furnaces.

Prerequisite: Course 9 of Department IV.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Text:

IV. DEPARTMENT OF CIVIL ENGINEERING.

PROFESSOR COGHLAN,

MR. BARKLEY.

In Civil Engineering, the first three years are devoted to the ıstery of those sciences upon which all professional engineering actice is based. In addition to a thorough mathematical train-g, particular care is taken to familiarize the student with the ıstruction, care and use of engineering instruments. To this l, in addition to the regular class-room work, much time is given field work, wherein a great variety of practical problems are ated. Attention is also given to the study of engineering mater- and their adaptation to various structures.

n the work of the fourth year the student is given instruction Structural, Sanitary, and Hydraulic Engineering. The work ch is largely drawing and design, covers practical problems, ı the intent that the student may become thoroughly familiar ı the principles governing his profession and with their appli-on.

he School offers great advantages in the line of Hydraulic and gation Engineering. Besides being situated in a distinctly irri-on country, it is also in reasonable proximity to two of the est projects of the United States Reclamation Service, where latest and best methods may be studied.

udents have usually been able to attach themselves during the ner vacation to the regular surveying parties of railway, irri-n or mining companies.

lechanical Drawing and Lettering.

ıis course comprises the drawing of 20 plates in the geomet- representation of objects by isometric and orthographic pro-ns. Objects in various positions are projected orthograph- and the relations between the different views are brought sections at different positions and the intersections of solids presented. The principles of linear perspective are discussed pplied to the representation of some simple objects.

e latter part of the semester is devoted to special practice in

lettering, free hand sketching and in the construction of appropriate and attractive letters for maps and engineering plans.

Prerequisites: Entrance requirements.

Time: Laboratory, eight hours a week, first semester.

Texts: Tracy, *Mechanical Drawing.*
Reinhardt, *System of Lettering.*

2. Mechanical Drawing and Lettering.

A continuation of Course 1. Here the student is made to cop plates from a standard text on drawing. He thereby become familiar with the methods of dimensioning, laying out, and read- ing working drawings. Through the entire course, particula stress is laid upon neat lettering and symmetrical arrangement o drawings. In this course the student is taught how to trace an blue print.

Prerequisite: Course 1 of this department.

Time: Laboratory, six hours a week, second semester.

Text: Anthony, *Machine Drawing.*

3. Descriptive Geometry.

The representation of all geometrical magnitudes by means orthographic projection, the solution of problems involving point lines, surfaces and solids, descriptions of and problems relative warped and double-curved surfaces, intersections of lines and su faces.

Prerequisites: Course 2 of Department I, and Course 1 of th department.

Time: Class-room, three hours a week, second semester.

Text: Church, *Descriptive Geometry.*

4. General Surveying.

The introductory course in surveying deals with the princip of land measurement, and with the instruments used in both fi and office.

In the class-room, the adjustments of the level and transit taught, and the uses of these instruments in land surveying ill- trated by practical problems.

In the field practice, each student becomes familiar with use of the chain, tape, level, transit, etc.

Prerequisite: Course 2 of Department I.

Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.

Text: Pence and Ketchum, *Surveying Manual.*

5. Mine and Railroad Surveying.

The work consists of field work, recitations, and drafting room practice.

In the field work, a complete survey of a mining claim is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. In addition a complete survey of the underground excavations is made. Practice is also given in the laying out of railway curves and switches.

In the drafting room maps are made from the notes taken in the field practice. The value of careful work in the field and correct notes is thereby emphasized.

In the class-room, the principles of mining law are taught, and problems dealing with the connection of surface and subterranean workings are solved. The methods of computing and laying out railroad curves are studied.

Prerequisite: Course 4 of this department.

Time: Class-room, four hours a week, first semester.
Field, four hours a week, first semester.

Texts: Underhill, *Mineral Land Surveying.*
Allen, *Railway Curves.*

6. Topographical Surveying.

The theory and use of the stadia and other instruments used in making a topographic survey are considered, as are also the methods of topographic surveying. Some time is given to topographic drawing. A complete topographic survey based on a system of triangulation is executed, including the calculations, and platting and completing the map. Some attention is given to the precise measurement of bases and angles.

Prerequisites: Courses 4 and 5 of this department.

Time: Class-room, two hours a week, second semester.
Field, four hours a week, second semester.

Text: Wilson, *Topographic Surveying.*

7. Railway Location.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length.

Prerequisites: Courses 4, 5 and 6 of this department.

Time: Class-room, one hour a week, first semester.
Field, eight hours a week, first semester.

8. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and charactertistics of good highways; location, construction, drainage, improvement and maintenance of country roads; various paving materials,—broken stone, brick, asphalt, wood and stone blocks, and concrete; foundations for and adaptability of each; arrangement and details of city streets.

Prerequisite: Course 4 of this department.

Time: Class-room, three hours a week, first semester.

Text: Baker, *Roads and Pavements.*

9. General Physics I.

Mechanics, molecular physics and heat are studied.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and Efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Pressure-expansion of gases; (14) Heat-expansion of gases; (15) Archimedes's principle; (16) Calorimetry.

This course is intended not only to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained, but also to give him a better understanding of the laws of physics and of the real significance of physical constants.

Prerequisite: Course 2 of Department I.

Time: Class-room, three hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Millikan, *Mechanics, Molecular Physics and Heat.*

General Physics II, see Department III, Course 15.

10. Kinematics and Machines.

The object of this broad but elementary course in mechanical engineering is to familiarize the student early in his work with

the mechanisms and appliances by which power is generated, transmitted, and utilized; to give him the essentials of the use of tools and machines, and their proper care; and to give him an introduction which shall assist in the subsequent detailed study of machines under the heads of power engineering and mining.

The topics treated are: (a) Nature of machines; methods of transmitting motion in machines; contact mechanisms; friction and tooth gears; cams, link work; trains of mechanisms; chains, ropes, and belts; couplings, etc. (b) Classification and comparative description of typical machines; mechanisms of simple engines and pumps; valve and reversing-gears, etc. (c) The care of tools and machines.

Time: Class-room, two hours a week, second semester.

11. Power and Power Transmission.

The various sources of power are discussed briefly, steam and other heat engines as the great sources of power being studied in considerable detail; the boiler and furnace with their accessories; the engine with its connections and controlling mechanism.

Lectures are given on the transmission of power by shafting, gearing, and compressed air; water-power and electric transmission and distribution of power; the general principles of the transmission and transformation of electrical energy.

Prerequisites: Course 15 of Department III and Courses 9 and 10 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hutton, *Mechanical Engineering of Power Plants.*

12. Machine Design.

A study of the design of machine-elements and modern machines, and of the nature, strength, and action under stress of the materials used in machine construction. Lectures and recitations are carried on, Unwin's *Machine Design,* Part I, being used as a reference. In the draughting-room, the problems taken up in the lectures are made the subject of draughting-work.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, second semester.
Laboratory, four hours a week, second semester.

Text: Low and Bevis, *Manual of Machine Drawing and Design.*

13. Graphic Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These meth-

ods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 1 of Department II.

Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second semester.

Text: Malcolm, *Graphic Statics.*

14. Railroad Tracks, Yards, and Structures.

Instruction is given in the methods of proper location of railroad yards to insure efficiency of operation. The details of track construction are studied. Each student makes a drawing of some railroad structure, the dimensions being of his own measurement.

Prerequisite: Course 8 of this department.

Time: Class-room, four hours a week, second semester.

Text: Tratman, *Track.*

15. Stresses.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow, and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind, and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisites: Courses 1 and 2 of Department II.

Time: Class-room, two hours a week, one year.

Text: Merriman & Jacoby, *Roofs and Bridges,* Part I.

16. Structural Details.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures. Each student makes a detailed design of a steel roof truss with its supporting columns, a plate girder bridge for railroad traffic, and a highway Pratt truss span.

Prerequisites: Courses 1 and 2 of Department II, and Course 15 of this department must accompany.

Time: Laboratory, nine hours a week, one year.

17. Water Supply Engineering.

The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, methods of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisites: Courses 1, 2 and 3 of Department II.

Time: Class-room, five hours a week, first semester.

18. Masonry.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cements, wood, iron and steel. Special emphasis is placed upon the geological occurrences to the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe, and stone arches.

Prerequisites: Courses 1 and 2 of Department II.

Time: Class-room, five hours a week, first semester.

Text: Baker, *Masonry Construction.*

19. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, second semester.

Text: Johnson, *Engineering Contracts and Specifications.*

20. Sewerage and Drainage.

A study of the quantity of house-sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisites: Courses 1, 2, and 3 of Deparment II.

Time: Class-room, five hours a week, second semester.

Text: Folwell, *Sewerage.*

21. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisites: Courses 1 and 3 of Department II, and Course 15 of this department.

Time: Class-room, two hours a week, second semester.

22. Mine Constructions.

Under the head of Mine Construction, the application of the principles of Civil Engineering to the structures most frequently required in mining is taken up. Mine buildings, bins, head-frames, trestles, crane-girders, fast-plants, tanks, etc., are studied as to form and materials of construction. The stresses produced in the members of these structures by the various kinds of loading, and the calculations of these stresses by algebraic and graphic methods are taken up.

In the laboratory the problems incident to design are solved and typical structures are designed and finished drawings made.

Prerequisites: Courses 1 and 2 of Department II, and Course 15 of this department.

Time: Drafting-room, twelve hours a week, first semester.
Drafting room, nine hours a week, second semester.

V. DEPARTMENT OF MINING GEOLOGY.

Doctor Paul.

This department aims to give its students knowledge concerning bodies of ore and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditions, so that mining may become more and more a business and that the element of chance may be lessened.

1. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts ,salts of the or-

ganic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 2 of Department III.

Time: Class-room, three hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Dana, *Text-Book of Mineralogy.*
Warren: *Manual of Determinative Mineralogy.*
Butler, *Handbook of Minerals.*

2. General Geology.

All of the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions

The instruction is conducted by means of lectures, recitations, laboratory examinations and frequent excursions into the field and is designed to familiarize the student with the data of geology. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail, training in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Limitar mountain, ten miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these

illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, second semester.
Field, alternate Saturdays, 8:30—5:00.

Texts: Le Comte, *Text-Book of Geology.*
Geikie, *Text-Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Geikie: *Structural and Field Geology.*

3. Historical Geology.

The development of the North American continent with special reference to the United States is taken up to show the past geologic and geographic conditions. It embraces the stratigraphy and the general geologic structure, showing the character of the sediments at different times. Fossils, the time-markers of rocks, are introduced wherever possible and the student becomes familiar with the conditions of deposition and the fossils characteristic of different periods.

Prerequisite: Course 2 of this department.

Time: Class-room, two hours a week, first semester.

Texts: Le Comte, *Text Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Zittel-Eastman, *Paleontology.*

4. Geological Mapping.

Each student is assigned a limited area, often one square mile, and makes a topographic and geologic map of it, the method used being that of compass-traverses, and intersections. The map and report give detailed information as to the rocks; their character, attitude, relative age, and history. Contacts are traced out and plotted, the relation of the various rocks to each other being sought and the structure studied. The class-room work is devoted to discussion of questions arising in the field.

Prerequisites: Course 4 of Department IV, and course 2 of this department.

Time: Class-room, one hour a week, one year.
Field, alternate Saturdays, one year.

5. Economic Geology, A.

This course embraces the study of ore deposits, first taking up the formation of open spaces, the filling of these spaces, the classification of veins and the theories of ore deposition. Different classifications of ore deposits are then discussed and examples given of each type of deposit, using Spurr as a text.

In the second half of the course, the iron ores are first considered, then those of copper, gold, silver and gold, silver and lead, lead, lead and zinc, zinc, etc., using Kemp as a text. The course includes lectures and much collateral reading.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, three hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Beck, *The Nature of Ore Deposits.*
Spurr, *Geology Applied to Mining.*
Clarke, *The Data of Geochemistry.*

References: Posepny, *Genesis of Ore Deposits.*
Kemp, *Ore Deposits in the United States and Canada.*
Phillips, *A Treatise on Ore Deposits.*
Bulletins, monographs, folios, etc., of the United States Geological Survey.
Economic Geology and other mining magazines.

6. Economic Geology, B.

This course embraces the study of deposits of non-metallic minerals of economic importance, the geologic aspect being emphasized. The substances considered are coals, oils, gas, clays, cement rock, limestone, salt, gypsum, sulphur, fertilizers, abrasives, gems and minor minerals.

Prerequisites: Courses 1, 2 and 7 of this department.

Time: Class-room, two hours a week, second semester.

Text: Ries, *Economic Geology of the United States.*
Thompson: *Petroleum Mining.*

References: Merrill, *Rock-forming Minerals.*
Crosby, *Chemical Geology.*
Mineral Industry of the United States.
U. S. G. S. Publications.

7. Petrology.

In the study of rocks, special emphasis is given to the texture and to the mineral composition as determined by a hand lens and knife, with the purpose of acquiring the ability to make a classifi-

cation in the field. First, the igneous rocks are studied, then the sedimentary rocks and finally the metamorphic ores.

The student in the microscopical portion of this subject devotes his time, firstly, to the determination of the optical properties of rock and vein forming minerals and, secondly, to the determination of rocks in thin sections.

The admirable collection of rock sections with corresponding hand specimens owned by the School enables the student to become familiar with all kinds of rocks both megascopically and microscopically.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Texts: Kemp, *Hand-Book of Rocks.*
Pirsson, *Rocks and Rock Minerals.*
Winchell, *Elements of Optical Mineralogy.*
Rosenbusch-Iddings, *Microscopical Physiography of Rock-Making Minerals.*

References: Rosenbusch, *Gesteirslehre.*
Iddings, *Igneous Rocks.*
Geikie, *Text-Book of Geology.*
Clarke, *Data of Geochemistry.*

8. Geological Surveying, A.

In this course, the students are divided into pairs, each pair working on an area of fifteen or twenty square miles. First, reconnaissance trips are made over the district and, later, detailed work is done and the contacts and relative ages of rocks determined, Each pair of students make a geologic map and report of their district, particular attention being given to problems of structure, ore deposits, etc. The Socorro sheet of the topographic maps issued by the United States Geological Survey is used as a base-map.

Prerequisites: Courses 1, 2 and 4 of this department.

Time: Class-room, one hour a week, first semester.
Field, every Saturday, first semester.

9. Geological Surveying, B.

This is more advanced than the preceding course and deals with problems in structural and dynamic geology, petrography, ore deposits, stratigraphy and correlation.

Prerequisite: Course 8 of this department.

Time: Class-room, one hour a week, second semester.
Field, eight hours a week, second semester.

10. Ore Deposits, A.

Theories of ore deposition are taken up in greater detail than in Course 6 and are subjected to more critical study and the role of igneous rocks in the formation of ore deposits is treated more elaborately than in the latter course. Conditions governing the formation of spaces, water circulation, precipitation and the filling of spaces, replacement, rock alteration and parageneses of minerals are taken up. The original literature is consulted wherever possible and much collateral reading is done.

Prerequisites: Courses 6 and 9 of this department and Courses 1, 2 and 3 of Department VI.

Time: Class-room, two hours a week, first semester.

Text: Posepny, *Genesis of Ore Deposits.*
Economic Geology.

11. Ore Deposits, B.

This is a continuation of course A and consists of the critical reading of other papers in Posepny's Genesis of Ore Deposits. In the second part, original literature concerning the newer mining camps is studied in an analytical way.

12.—Paleontology.

A brief view of the fossils is taken with special reference to the geological succession in Southwestern United States. Characteristic types of each of the geological periods are studied with care. The methods of determining geological horizons by means of fossils are discussed and allusion made to geological correlations.

Prerequisites: Courses 2 and 3 of this department.

Time: Class-room, three hours a week, first semester.
Field and laboratory, three hours a week, first semester.

Text: Zittel-Eastman, *Paleontology.*

13. Abstracts.

Various articles in the current numbers of mining magazines are abstracted by the students and presented to the class.

Prerequisite: Course 5 of this department should accompany or precede.

Time: Class-room, three hours a week, first semester.

14. Special Problems.

It is expected that the student has already become more or less familiar with the various districts in the neighborhood of the School. He is encouraged to take up the exhaustive study of some limited area, in conjunction with, or under the guidance of his

instructor, or he is given some area or theme that has already been well worked out and the results published, and he is required to repeat the investigation on his own account. There is a wide range of topics from which to select. Nearly all departments of geology offer problems that are both varied and highly instructive.

15. Valuation of Ore Deposits.

In this course special attention is given to methods of determining the shape, size and richness of ore deposits; for, on these three factors depend the value of the mine, and the mining methods used in extracting the ore. In considering the dimensions of ore deposits, the general geological relations in the district are first taken up, then the local geological structure is worked out in detail, especial attention being given to contracts, stratigraphy, faults, and joints as criteria for locating cut-off or "lost" ore bodies. Methods of estimating the amount of probable ore and possible ore in the mine, and the volume of dumps are also discussed. A great deal of importance is attached to sampling; methods of obtaining representative samples, frequency of samples, assay of samples, interpretation of assays, preparation and interpretation of assay maps in determining ore shoots, and methods of guarding against "salting" being discussed. The probable location, amount, and richness thus being determined, development work is put on a more scientific basis and mine valuation (the frequent duty of a mining engineer) is made more exact.

Prerequisites: Courses 5 and 8 of this department.

Time: Class-room, two hours a week, second semester.
Field, six hours a week, second semester.

VI. DEPARTMENT OF MINING ENGINEERING.

PROFESSOR TUTTLE.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. The entire course is pre-eminently practical in character.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Examination of mineral properties; relation of topography to geological structure; tracing of probable outcrops.

Prospecting by panning, trenches, test pits, boring and drilling.

Testing of placers and ore deposits with well or chain drills.

Development; choice of methods; location of openings.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts, submarine blasting; quarrying.

Tunnelling: Methods of driving and timbering; submarine tunnels; permanent linings; sizes, speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Ore extraction by systems of overhead and underhand stoping; caving by top slicing and sub-drifting; support of workings by filling and square-setting.

Surface workings and hydraulic mining.

Placer dredges.

Steam shovel excavation of ore.

Prerequisites: Courses 1, 2 and 3 of Department I; Courses 1 and 15 of Department III; Courses 9 and 10 of Department IV.

Time: Class-room, four hours a week, first semester.
Texts: Hoover, *Principles of Mining.*
Gilette, *Rock Excavations.*
Foster, *Ore and Stone Mining.*

2. Mining, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Water supply.

Drainage: Sources, control and raising of mine waters; dams; drainage-levels.

Ventilation: Requirements for pure air; vitiation and purification of mine-air; methods of ventilation; measurement and control of air-currents.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.
Time: Class-room, four hours a week, second semester.
Texts: Same as in Course 1.

3. Inspection of Mining Methods.

By inspection of mining methods followed in the various camps in the neighborhood of the School there is afforded great variety of illustration of the themes developed in the lectures.

The inspections are carried on partly as class-work in company with the instructor in charge, and partly as individual work. Full notes are required to be taken and these are subsequently reduced in the office to proper form, accompanied by the necessary sketches and plans to make the whole procedure thoroughly intelligible.

Required as a two-weeks' trip to be made by all students of Mining Methods.

4. Ore Dressing.

This course includes a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil and acid flotation.

Prerequisites: Course 1 of Department I; Course 3 of Department II; Course 15 of Department III; Course 9 of Department IV.

Time: Class-room, three hours a week, first semester; two hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration.*

5. Mine Plant.

The following machinery and appliances are studied and critically discussed.

Hoisting: Engines, drums, wire rope, skips and cages; head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Arrangements at top and underground landings: Ore pockets; signalling, etc.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiencies of fans.

Air-compressors: Straight-line and duplex; simple and compound compression; heat of compression; conveyance of compressed air; efficiencies.

Machine drills: Construction and operation.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives; comparative efficiencies.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, three hours a week, one year.

6. Design of Mine Plant.

The student is assigned problems relating to a given mine. He makes the requisite surveys, plans the top-works, designs the requisite machinery for a specified duty, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or of the Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings. This work, when further elaborated, may be accepted as a thesis.

Time: Laboratory, three hours a week, one year.

7. Mine Administration and Accounts.

Particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of supplies, and the sale of ore prepared for market are taken up, and mine accounts, statements of cost, and monthly reports are discussed.

Time: Class-room, two hours a week, second semester.

8. Examinations of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside constructions, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant.

Time: Class-room, one hour a week, second semester.
Field, six hours a week, second semester.

COAL MINING ENGINEERING.

As New Mexico contains about ten million acres of coal land, and as this coal land is beginning to be developed on a large scale, it has been thought advisable to offer some special courses in Coal Mining Engineering.

Five operating coal mines are within twenty-five miles of the School, and are open for inspection and study. Some of the model coal mines and coking plants of the country are located in the northern part of the Territory and the Christmas vacation can be spent with an instructor inspecting these operations.

The Cerrillos Anthracite District is another profitable field for inspection trips.

If five students signify their intention of taking up Coal Mining, the following courses will be offered the first semester: Geology of Coal, Coal Mining Methods, Coal Breaking and Coking. Prospective students in this work are requested to communicate with the School at their earliest convenience, giving a statement of their study, training and experience in coal mining.

Geology of Coal.

In this course the origin of coal, the different kinds of coal, the structure of coal, its variations and irregularities, and the nature of the outcrop are considered. Features such as geologic structure and associated rocks common to all coal fields are then discussed, followed by a detailed study of the different coal fields, with a view of familiarizing the student with the geologic features of coal and the large features common to coal fields. A real geological mapping of a coal mining region is also carried on with a view of determining the method of access to a certain coal seam (shaft, slope, or drift), and the best location for the mouth of the workings.

Coal Mining Methods.

The methods of breaking the coal dependent on its structure, attitude, and thickness are first taken up, followed by descriptions of the different systems of coal mining such as room and pillar, long wall advancing, long wall retreating, mining in benches, etc. The different systems of haulage; animal, endless rope, main-and-tail rope, compressed air, electric locomotives, etc., are taken up. The subject of ventilation receives considerable attention, as does the subject of mine explosions.

Coal Breaking and Coking.

Devices used in handling and breaking and sizing coal for market are first considered, followed by a discussion of machines used

for washing coal. Then the study of coke manufacture is taken up; first the quality of coal suitable for coking, its preparation for the ovens, and then a critical study of the different kinds of coke ovens, methods of charging, time of burning, and method of drawing the coke. During the Christmas recess an inspection trip is made to the Raton field where the different features of coal mining can be seen at their best.

VII. DEPARTMENT OF METALLURGICAL ENGINERING.

PROFESSOR TUTTLE,

MR. BARKLEY.

The aim of the Metallurgical Department is to give its graduates a thorough working knowledge of assaying, chemistry, millwork and smelting processes; and to equip them with the knowledge necessary to the successful management of metallurgical plants, or to take charge of metallurgical operations.

This special training is given by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead: The crucible-assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assayers are considered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Courses 1, 2 and 3 of Department III, and Course 1 of Department V.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Texts: Lodge, *Notes on Assaying.*
Furman, *Manual of Practical Assaying.*

2. Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

Particular stress is laid upon the study of the more recent metallurgical practices and improvements of older processes.

The course is supplemented by visits to neighboring plants and ,at the end of the school year, by vacation trips of metallurgical inspection.

Prerequisites: Course 1 of Department III; Course 9 of Department IV, and Course 1 of Department V must precede or accompany.

Time: Class-room, three hours a week, second semester.

Text: L. S. Austin, *Metallurgy of the Common Metals.*

3. Furnaces.

This course is given by way of an extension of the topic "furnaces" as treated in General Metallurgy. It is concerned with the theories of high temperature generation, heat conservation, measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three hours a week, first semester.

Text: Demaur, *Industrial Furnaces.*

4. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet types of ore hearth; smelting lead ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.

Time: Class-room, two hours a week, first semester.

Text: Peters, *Principles of Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel processes; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, five hours a week, second semester.

Terts: Rose, *Gold.*
Collins, *Metallurgy of Silver.*

7. Metallurgy of Iron.

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron; gray cast-iron and spieged-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.

Time: Class-room, four hours a week, second semester.

Text: Howe, *Metallurgy of Steel.*

8. Metallurgical Inspection.

Visits of inspection to mills and reduction-works. While these visits are required during the third year only, at which time the student is capable of understanding all he sees and thus deriving the maximum amount of benefit from it, students not so far advanced are advised to take these trips whenever it does not conflict with other studies.

A visit may be extended by special permission and the mill or reduction-works used to furnish the material for a thesis.

9. Metallurgical Plant and Design.

Some time during the latter part of the general course in metallurgical engineering, the student devotes a part of his time to

detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two students have the same work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans for part of the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bills of materials made out for the portions of the work assigned, and the cost of the several parts carefully estimated according to the trade conditions and labor factors existing at the time. The entire work and all computations are carried out according to the best engineering practice and with the same care that actual construction operations require.

Prerequisites: Courses 1, 2 and 3 of Department II; Course 6 of Department V, and Course 2 of this Department.

Time: Class-room, one hour a week, first semester.
Laboratory, three hours a week, first semester, and six hours a week, second semester.

VIII. DEPARTMENT OF LANGUAGES.

Professor Drake.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge; for, in Socorro and vicinity, Spanish is as generally spoken as English.

Either French or German may be taken in place of Spanish if a sufficient number of students apply.

1. Spanish. (Optional.)

The work is based on Worman's First and Second Spanish Readers. A part of the class exercise each day consists in cross-tranlations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language with the idea of learning the grammar from the language rather than the language from the grammar.

Time: Two hours a week, one year.
Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish. (Optional.)

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar* being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.
Time: Two hours a week, one year.

ACADEMIC DEPARTMENT.

The requirements for admission to the Academy are the same as those for standard secondary schools. A two-year course is offered, the work therein corresponding to that of the ninth and tenth grades of the standard high school.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

FIRST YEAR—FIRST SEMESTER.

Elementary Algebra.

To the subject of simultaneous linear equations, including the four fundamental operations; factoring, including the determination of the highest common factor and the lowest common multiple; linear equations; and problems depending on linear equations.

Time: Five hours a week.

Text: Wells, *Algebra for Secondary Schools.*

English I.

The Merchant of Venice, Bunker Hill Oration, and Snowbound are read and discussed in class. Some memorizing of significant passages is required. In the composition work, an attempt is made to interest the student at once in narrative writing, fluency and correctness of expression being sought primarily. Later in the year the work verges into exposition. During this semester each student is required to read and pass an examination in two of the following supplementary books: Ivanhoe, Tales from Shakespeare, Autobiography of Franklin, Tom Brown's School Days, Robinson Crusoe, The First Jungle Book, and Pilgrim's Progress. Reading Course examinations are held about the middle of November and the first of January.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physiography.

Wherever possible, in this course, facts obtained by actual observation are made to verify and supplement the text used. There are daily assigned observations of clouds, winds and temperature, and a study of erosion by wind and by water and of geologic formation is made in excursions to near-by arroyos and canyons. In connection with the study of stream-flow, attention is called to the great importance of forest preservation to the people of the West.

Time: Five forty-five minute periods a week.

Text: Fairbanks, *Practical Physiography.*

FIRST YEAR—SECOND SEMESTER.

Elementary Algebra.

Radicals, including the extraction of square root; exponents, including the fractional and negative; quadratic equations; problems depending on quadratic equations; the binomial theorem for positive and negative exponents.

Time: Five hours a week.

Text: Wells, *Algebra for Secondary Schools.*

English I.

A continuation of the first semester's work in this subject. Shakespeare's Temptest, Eliot's Silas Marner, and Bryant's Sella and Thanatopsis are read and discussed in class. As in the first semester, each student is required to read and pass examination in two of the supplementary books offered in this course. These examinations will be given in March and May.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physiography.

The work during the second semester is a continuation of that of the first. A book of notes is kept by each pupil, during the year, based on the text, and on practical observation and research.

Time: Five forty-five minute periods a week.

Text: Fairbanks, *Practical Physiography.*

SECOND YEAR—FIRST SEMESTER.

Plane Geometry.

The usual theorems and constructions of good text-books, including the general propositions of plane rectilinear figures; the circle and measurement of angles; similar polygons; areas; regular polygons; and the solution of numerous original exercises.

Time: Five hours a week.

Text: Wells, *New Plane and Solid Geometry.*

English II.

Julius Cæsar, Richard III, and the Letters of Washington are studied in class. The same plan is pursued in the writing work as in English I. This semester each student is required to read and pass examination in two of the following supplementary books: Tale of Two Cities, David Copperfield, Hoosier Schoolmaster, Last of the Mohicans, Vicar of Wakefield, and assigned portions from The Sketch Book. These examinations will be given as in English I.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physics.

This course runs throughout the entire year, the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. The splendid equipment of physical apparatus renders it possible to supplement the text by daily experiments and demonstrations. During this semester the subjects of mechanics and heat are treated.

Time: Five hours a week.

Text: Carhart and Chute, *High School Physics.*

History.

For the benefit of those who have not had the opportunity to study Ancient History a brief review of that subject is made. Grecian and Roman History are given their proper emphasis. Special attention is paid to the History of Western Europe since the barbarian invasion, with emphasis on the bearing of old-world events upon the history of the Americas. In the study of such things as the mediaeval town, life in the feudal castle and the Renaissance, an attempt is made to cause the student to realize

these things as aspects of the daily existence of common men and women, which he would have lived likewise under like conditions, rather than to obtain a fixed mental chronology of dates and occurrences. Frequent written reviews are given throughout the course. Essays on certain assigned historical subjects are required.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

SECOND YEAR—SECOND SEMESTER.

Solid Geometry.

The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders, and cones; the sphere; and the spherical triangle.

Time: Five hours a week.

Text: Wells, *New Plane and Solid Geometry.*

English II.

During the second semester the student's time and attention are devoted to a study of the history and development of English Literature. Extracts from the classics are read and discussed in class; note books are kept based upon the text studied.

Time: Five forty-five minute periods a week.

Text: Long, *English Literature.*

Physics.

This is a continuation of the first semester's work. Electricity, sound, and light are treated in much the same manner as the subjects of the first half of the year.

Time: Five hours a week.

Text: Carhart and Chute, *High School Physics.*

History.

This is a continuation of the first semester's work.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

PHYSICAL TRAINING.

Physical training has become a distinct feature of the student's activity at nearly all institutions of higher education. Rationally indulged in it is an exceedingly valuable feature, as is attested by both reason and experience. It is superfluous to argue that a sound mind and an unsound body constitute a very unfortunate

combination. The ideal young man of the day, the young man who gives promise of greatest usefulness, is sound in both mind and body. The health of the body and the consequent health of the mind can not be promoted without proper attention to the laws of physical exercise. Physical training thus becomes, as it should become in an educational institution, a valuable means for the accomplishment of the very end and aim of the institution itself.

At the School of Mines athletics has been receiving increased attention in the last few years. There is now a well organized athletic association, and foot-ball, base-ball, basket-ball, lawn tennis, and track events are dividing the attention of the members of the association. The foot-ball and base-ball teams made a good record for themselves last season and they are confidently anticipating better records for 1911. It is to be hoped that an intercollegiate athletic association will soon be organized among the students of the respective collegiate institutions of New Mexico; in fact, the subject of the organization of such an association has already been considerably discussed. When the organization is perfected, the School of Mines may be expected to give a good account of itself in an athletic way.

Care is taken, however, and will continue to be taken to make athletics merely a means of keeping the young men at the School of Mines in the best possible physical condition to do the work for which they came to the institution. While it accomplishes this purpose it naturally fosters and develops a strong college spirit, and this, too, is a species of enthusiasm that is by no means to be despised in the work of educating young men for the activities of their later years.

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus is situated on the northwest edge of Socorro. It contains 20 acres of nearly level ground within the irrigable belt. Groves of trees have been planted and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet deep, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite in broken ashler and is trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated, heated with a good hot-water system, piped for water and gas, and wired for electricity for illumination and for experimental purposes.

As now arranged the main floor of this building contains the president's office, the mineralogical museum, the qualitative chemical laboratory and instructor's office, the assay laboratory and balance rooms, and a lecture room. The basement contains two lecture rooms, the physical laboratory, an instructor's private mineralogical laboratory, the quantitative chemical laboratory, the electro-chemical laboratory, an instructor's private chemical laboratory, the chemical supply rooms, a photographic dark room, the boiler room, the engine room, the hot water heating plant, and the lavatories. A lecture room, now occupied by the department of mathematics, is located on the second floor. The main library occupies the third floor.

Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion the building is to be X-shaped, the central pavilion two stories and the four wings one story. With its spacious rooms it will be peculiarly adapted to engineering instruction.

When the building is completed the entire north wing will be devoted to draughting purposes, the light coming from above. At present the main draughting-room is in the south wing which also is a lecture room. Off this are the instructor's office and a blue-

print room. A photographic room is fitted up in the main building.

Dormitory.

The School of Mines suffered long for lack of dormitory accommodations. In fact, it is known that many students who would otherwise have come to the School of Mines in years past went to other institutions because of the lack of the lower cost of living which a dormitory here would have afforded. However, the $15,000 generously appropriated by the territorial legislature was expended with the result that the School of Mines is equipped with what is probably the best dormitory in New Mexico. The building is heated with hot water and lighted with electricity. There are a dining room and kitchen in connection, also a bath room on each of the two floors and a shower bath in the basement. The assembly room on the first floor, which is now equipped for the accommodation of the academic department, promises to meet all the requirements of that department for some time to come. The building is designed to afford accommodation for about thirty students and is occupied to practically its full capacity. The dormitory contributes greatly to the convenience and comfort of the students in attendance at the School of Mines and is sure to be an important agency in increasing that attendance.

It has already been demonstrated that students can be accommodated with board and lodging at the dormitory at the rate of $20 a month, they being required to furnish only heir own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself, and no student will be accommodated in this way to the exclusion of another student from dormitory privileges. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture. After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application.

EQUIPMENT.

Chemical Laboratories.

The chemical laboratories have recently been greatly enlarged and improved. As now arranged they occupy the entire south wing of the main building, while the store rooms, private laboratory, and chemical lecture room are located in the central section of the same building. Elements of chemistry and qualitative analysis are taught in the large laboratory on the main floor. The room, which is exceptionally well lighted and ventilated, is equipped with large hoods, a balance room, and twenty-four desks, each of which is supplied with gas, water, and electric light.

The basement laboratory has recently been remodeled and fitted with large windows, glass partitions, and modern desks. The east half of it is used for quantitative analysis and wet assaying. There are large hoods in each end which are supplied with hot plates and drying ovens, while each desk is equipped with an Alberine stone sink, water, gas, and electric light.

In the west half of the basement there are the instructor's laboratory, electro-chemical laboratory, and balance room. The latter is fully equipped with the best analytical balances supported upon a solid concrete table which is entirely free from vibration. The electro-chemical laboratory is supplied with current from a modern storage battery plant, consisting of a motor-generator, storage cells, and a switch-board so arranged that each student may obtain any current he desires for analytical or other electro-chemical experiments. There is also a supply of alternating current from the city circuit which is used for light and small electric furnaces.

The laboratory is very completely equipped not only with all apparatus, chemicals, and supplies needed for the various courses, but the stock includes a large amount of pure chemicals and special apparatus, including standardized burettes, flasks, and weights which are used for the most accurate rock analysis and research work.

All apparatus is loaned to the students. Chemicals and supplies are furnished at cost.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types and large muffle-coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes, and other assaying materials and supplies.

A weighing-room containing a number of Becker's balances is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher and a Bolthoff sample-grinder and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers, and other necessary apparatus.

Physical Laboratory.

The physical laboratory occupies the north end of the north basement of the main building and contains the usual apparatus for illustrating the facts and laws of physics. In addition there has just been added at a considerable expense all the apparatus necessary to perform the quantitative experiments outlined in Course 9 of Department IV.

Petrographical Laboratory.

For the microscopic study of rocks both in elementary and advanced or graduate work the School is well supplied with microscopes and other necessary apparatus. There has recently been added to the equipment a new style large microscope manufactured especially far this institution by Reichert of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model sub-stage with rack and pinion, an Abbe sub-stage condenser with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objectives and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparaus, stage micrometer, drawing apparatus, quartz-wedge, quarter-undulating micaplate, and other necessary pieces.

A rock-slicing machine with power attachments enables the student to prepare thin sections of the rocks which he is studying.

Among the series of thin-slices of rocks a collection of types of the massive crystallines of Europe prepared by Krantz of Bonn and completely illustrating Zirkel, sets of Maryland massives, and other Amercan rocks and minerals. The Sturtz collection of

European rocks illustrating Rosenbush and large miscellaneous collections are expected to be soon available for study.

CIVIL ENGINEERING DEPARTMENT.

This department has all the instruments necessary for land, railroad, irrigation, mine, and topographic surveys. These include chains, tapes, range-poles, level rods, wye and dumpy levels, complete transits, and plane tables. In purchasing instruments for this department only the best grade has been considered and the student has the opportunity to become familiar with the product of such well known manufacturers as Gurley & Sons, Eugene Dietzgen, Buff & Buff, etc.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the engineering building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame on steel track, developing-vat, and drying-rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. An Ingersol-Rand drill and other pieces of machinery are used as models.

Mineralogical Museum.

The School owns a very fine collection of minerals of all kinds. These properly labeled and arranged in glass cases are housed in the north wing of the main building.

The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school it attracted wide attention.

The display was planned to center around a large colored relief-model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model was shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases, were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals which for variety, deli-

cacy of coloration, and beauty have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the museum of the School of Mines.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats and atlases, and volumes on history, travel, and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.
Mining and Scientific Press.
Engineering Record.
Power.
Engineering News.
Mining Science.
Mines and Minerals.
Engineering Magazine.
American Chemical Journal.
Journal of Industrial and Engineering Chemistry.
Chemical Abstracts.
Review of Reviews.
Economic Geology.
School of Mines Quarterly.
New Mexico Journal of Education.
All the U. S. G. S. Publications.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions and authors' separates, pertaining to the respective divisions.

Powell Library.—The School has come into possession of the private library of the late Major John W. Powell of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology, and philosophy, many of which are rare and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great southwest. It was in these fields that Major Powell did most of his work which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who had been so long identified with this western country, should find a permanent home in New Mexico.

THE TORRANCE MINE.

The Torrance gold and silver mine at the base of Socorro mountain, only about two miles from the School campus, affords excellent opportunities for the practice of mine-surveying and for a study of some features of practical mining. The opening is a double-compartment incline shaft, timbered, with various levels, cross-cuts, winzes, shafts, and stopes. The ore-bodies with associated geological structures and many other features will interest the student of mining engineering.

INSPECTION VISITS.

Students in the mining and metallurgical courses are expected to make a two weeks' tour of inspection of the mines, concentrators, and smelters lying within easy reach of Socorro under the direction of the professor of mining and metallurgy. This tour may be made either during the Christmas vacation or at the close of the school year. Special stress is laid upon the proper keeping of notes. These are fully written up each day and are made use of later as a basis of other work in connection with the regular courses. If carefully kept they prove valuable references in later years.

Inspection visits have been made to the mines, concentrators, and reduction works at El Paso, Douglas, Bisbee, Tombstone, and Cananea.

On these visits, each student is instructed to make, from actual observation, notes, sketches, and drawings for a descriptive report,

his observation being directed by detailed suggestions concerning various features of mining operations. An illustration of these suggestions may be given as follows:

Hand-Drilling.

Depending upon where hand-drilling is being carried on, the student will describe, from actual observation, the details of the operation in the driving of either a drift, tunnel, cross-cut, shaft, slope, winze, or raise. In selecting a place, give preference to one of these in the order named.

Report as follows:

Give a list of tools used; as hammers, sledges, drills, bars, shovels, wedges, spoon, meed gun, tamping stick, crimper, etc. How many of each, size, weight, maker's name, brand, cost, etc. Quality of material in each. The form and size of steel and bits.

Make sketches in detail, showing two views of each tool, to scale with dimensions. Half size for small tools or where there are details to show, quarter size for large tools. The ends of long-handled tools and drills need only be shown.

An isometric view of any tool may be given if necessary for clearness.

Draw three projections of the working face, scale ½ inch to the foot, showing position, direction and depth of each hole.

Letter the holes in the order drilled and give numbers corresponding to the order in which they are fired.

Designate by corresponding letters, in a tabular statement, the time of day each hole was started, time completed, number and length of drills used per hole, size of bit at start and finish, number of sticks or depth of charge of powder per hole; its brand, strength, size, and weight; length of fuse in and out of each hole; kind of tamping used.

The student will draw in dotted lines work done during his absence.

If shots are fired by battery or magnets, show on the sketch of the working face the wiring and connections between the holes. Note size and length of wires between holes and to battery; capacity and make of battery. Describe and sketch electric fuse.

Give time charging of holes begins and ends; removal of tools prior to blasting; time fuses are lighted; time of first and last explosions; time for smoke to clear away and any means of hastening same; time of shovelling back, loading, and tramming and when completed; number of cars and tons of ore and waste from blast; time required to trim and square up the face; time drilling starts

on next round of holes; net advance per average depth of holes drilled; number of men employed drilling, loading, tramming, etc. Wages paid or contract prices; number of shifts and their hours; how many days the shifts work before changing their hours and how it is done; number of feet driven per month; analysis of cost per linear foot for drilling, shovelling, tramming, explosives, steel consumed, illuminants, etc.

Describe the nature, hardness, or other features of the rock or formation being drilled. Show in the sketches any planes, slips, or seams bearing on the position and direction of holes.

Describe the drilling of holes and note any difficulties encountered; depth drilled between the cleaning out of each hole; whether drilled dry or wet. Note positions of driller and hammer men, and how hammer is swung in drilling, "upper" and other holes. Compare speed in driving each.

Describe handling of explosives in charging a hole; the preparation of the fuse, cap, and powder. Show in a sketch, half size, how these are inserted and connected; and in a sketch, scale ½ inch to 1 ft., show the hole and the position of these in the hole and the depth of a charge of powder and tamping.

Describe causes of failure of any shot to do the work expected, and the work it actually did. Mark on the sketch and note causes of any holes missing fire or that are abandoned and how they are dealt with.

In a plan and side view, show the excavated lines of the sides, roof, and floor in relation to the dimension lines of the drift.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is twenty-five dollars a semester except to citizens of New Mexico, the tuition fee for the latter being ten dollars a semester. This is payable at registration and its payment after matriculation admits the student to all class-room instruction. Students who hold scholarships pay no fee for tuition.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water, and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Quantitative Analysis, Water and Fuel Analysis, Inorganic Preparations, Organic Chemistry, Electro-Analysis, Photography, Physics, each $5.00; Qualitative Analysis,, Ore Analysis, each $7.50; Fire Assaying, $10.00; Mineralogy (Blowpipe Analysis), $3.00.

A deposit of $2.00 is required from each student who registers for any one of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due for the breakage of apparatus.

Graduation Fee.

The graduation fee, payable before delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer	$10.00
Bachelor of Science	5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month; board at the hotels and best boarding-houses for $7.00 a week. The cost of living at the dormitory is $20 a month.

Books and Other Supplies.

Books and other supplies for students are furnished through the office at publishers' prices with the freight or express charges added. A considerable saving is thus made in behalf of the student.

Summary of Annual Expenses.

A close approximation of a student's necessary annual expenses is tabulated below. By the practice of extreme economy a student may, of course, cut his expenses somewhat below the figures here given.

Board and room at the dormitory	$180.00
Books and other supplies	60.00
Laboratory and other fees	20.00
Total	$260.00

SCHOLARSHIPS AND PRIZES.

Scholarships.

Through the generosity of the members of the Board of Trustees, of the Thirty-seventh General Assembly of New Mexico, and of the Allis-Chalmers Company, the New Mexico School of Mines has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

School of Mines State-Scholarships.—To one student from each state of the Union is open a scholarship yielding free tuition. Each scholarship may be held for one year and is assigned to that applicant who shows the greatest proficiency in subjects already pursued by him. Application must be made in writing to the President and in the case of those who have not been students in the School must be accompanied by a certified statement of subjects pursued and the grades received therein unless the applicant prefers to pass an examination in the subjects for which he seeks credit.

School of Mines County-Scholarships.—Scholarships are open to two students from each county in New Mexico. These scholarships yield free tuition and are subject to the same conditions as the State-Scholarships.

New Mexico Scholarships.—The Thirty-seventh General Assembly of New Mexico gave to each representative, to each councilman, and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the territory and provided an appropriation of $200.00 for each appointee.

Allis-Chalmers Scholarship.—To one member of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee, and Scranton, an opportunity for four months' study and employment in any of its plants and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an

exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Prizes.

The Brown Medal.—Hon. C. T. Brown of Socorro offers annually a gold medal to the student who, while doing a full year's work, has shown the greatest proficiency in the courses in Wet Assaying and Fire Assaying. The medal is awarded each year at commencement. Only those students are eligible as contestants for the medal who at commencement are found to have completed the courses named and, of course, the prerequisites to these courses.

In case of a tie in the grade of proficiency between two or more contestants, special specimens of ore are submitted to them for assaying, until the tie is broken.

SUMMER WORK.

The proximity of the School to mineral properties, mines, and smelters makes it easy for the student to secure employment during the summer (and during the Christmas vacation, if desired) and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years land-surveying, mine-surveying, geological surveying, assaying and mining, have been attractive fields of work for the students during the vacations.

DEGREES.

The degree of Bachelor of Science, Mining Engineer, and Civil Engineer are conferred by the Board of Trustees upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of this institution, have completed the prescribed collegiate courses of any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence

of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed courses of the four-year curriculum in Mining Engineering, Metallurgical Engineering, or Mining Geology, has presented an original and satisfactory dissertation in the line of his work, and has done two years of professional work of which one has been in a position of responsibility. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum, and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the Mining Engineer, except that the candidate substitutes, in some of his later work, courses which relate more directly to the profession he expects subsequently to follow.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but in each case the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidence of independent investigation to warrant its publication in whole or in part.

COMMERCIAL ANALYSES.

The wide demand which exists in the great mining district of the southwest for disinterested and scientific tests and practical investigations has led to the establishment by the New Mexico School of Mines of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible and accurate results assured by reason of the exceptional facilities of the laboratories of the School and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines."

A special circular is issued, giving the schedule of charges, other necessary information, and methods of preparing and shipping samples. Copies are mailed on application. By special resolution it is required that all charges shall be paid in advance.

Commercial Assaying.—The assaying for gold, silver, copper, lead, zinc, and the common metals is carried on in all its various phases. All work is run in duplicate and, in case of any non-concordant results, such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese, and the rarer metals such as uranium, vanadium, nickel, and cobalt are made according to the best methods.

Water Analysis.—The chemical analysis of waters for city-water supplies, boilers, and domestic use, and of mineral and mine-waters has of late assumed great importance. The chemical laboratory of the School is fully equipped for this work and in the case of bad waters remedies and methods to be used to improve the waters for specific purposes are suggested. A large number of analyses of waters from the southwest have already been made and very interesting results obtained.

Fuel Analysis.—Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coals of the region. Complete analyses and heat tests have been made of some of the principal deposits. With the work already done the results of new analyses are made of special value on account of the comparative figures that can be supplied.

DIRECTORY OF GRADUATES AND FORMER STUDENTS.

ARTHUR H. ABERNATHY. Mapimi, Mexico.

Student, 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, 1901; Assistant sampleman, Minera de Penoles Co., Mapimi, Durango, Mexico, 1909.

GEORGE C. BAER. Mogollon, New Mexico.

(B. S., New Mexico School of Mines, 1910.)
Assayer, Tri-Bullion Company, Kelly, New Mexico, 1910; Millman, Socorro Mines Company, Mogollon, New Mexico, 1911—.

C. E. BARCLAY. Maria, Texas.

(A. B. University of Virginia.)
Student, 1896-97. From Bowling Green, Kentucky.

JAMES HENRY BATCHELDER, Jr. Chloride, New Mexico.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)
Mining, Chloride, New Mexico, 1911.

THOMAS HORTON BENTLEY. Hermosillo, Sonora, Mexico.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)
Surveyor with Milbon and Raffles, Nacozari, Sonora, Mexico; 1910; Surveyor with Madden and Lock, Hermosillo, Sonora, Mexico, 1911—.

JAMES F. BERRY. Angangueo, Michiocan, Mexico.

Student, 1904-5. From Socorro, N. M. Assayer with American Smelting and Refining Company, at Aguas Calientes, 1905; Assayer City of Mexico, 1906-7; Chemist, Cia Metalurgica y Refinadora del Pacifico, Fundicion, Sonora, Mexico, 1907-8; Assistant Mine Superintendent, American Smelting and Refining Company, Angangueo, Michiocan, Mexico, 1909—

LOUIS AUGUST BERTRAND. Upland, Nebraska.

Student, 1895-6. From Conway, Iowa. Student Ecole Professionella de l'East, Nancy, Lorraine, 1890-95; Instructor in Mathematics and French, New Mexico School of Mines, 1895-96; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Company, Chihuahua, Mexico; Superintendent,- Carmen Mines, Coahuila, Mexico; Superintendent, Compania Mineros de Penoles, Mapimi, Durango, Mexico, 1901.

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†Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

* Deceased.

CHAUNCEY E. BUTLER.* Dedrich, California.

Student, 1893-6. From Kelly, New Mexico. Assayer, Cibolo Creek Mill and Mining Company, San Francisco, California, 1896; Assayer and Furnace Superintendent, La Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897-98; Chemist and Assayer, United Verde Copper Company, Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Company, and Jenny Lind and Maple Mining Company, Dedrich, California, 1903.

R. HARLAND CASE. Colorado Springs, Colorado.

Student, 1902-5. From Cerrillos, N. M. Chemist, Compania Metalurgica de Torreon, Torreon, Mexico, 1905-6; Assistant Superintendent Bonanza Mine, Zacatecas, Mexico, 1906; Assistant-Manager, Stephenson-Bennett Mining and Milling Company, Organ, New Mexico, 1906-7; Consulting Engineer, Western Mining, Milling and Leasing Company, Colorado Springs, Colorado, 1907-8.

EDWARD C. CHAMNEY. Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-1; Assayer, Oro Mining Company, Minnehaha, Arizona, 1901.

VIVIAN V. CLARK. Reiter, Washington.

Student, 1896-8. From Kelly, New Mexico. Assayer, Bland Mining Company, Bland, New Mexico, 1898-9; Superintendent, Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine Operator, Albuquerque, New Mexico, 1902; Manager, Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903; Consulting Engineer, Consoldated Exploration Mines Company, New York, and allied syndicates, 1909—.

DAVID JOSHUE CLOYD. Torreon, Coah., Mexico.

Student, 1899-1900. From Decatur, Illinois. Chemist and Assayer, Wardman's Assay Office, Aguas Calientes, Mexico, 1900-1906; Assistant Superintendent, Cia Minera del Tiro General, Charcas, S. L. P. and Assistant Superintendent, Cia del Ferrocarril Central de Potosi, Charcas, S. L. P., 1906-8; Assayer and Chemist Dailey, Wisner & Company, Torreon, Coah., Mexico, 1908.

SAMUEL COCKERILL. Milwaukee, Wisconsin.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-6. From North Fork, Virginia. Post-Graduate Engineering Course, Allis-Chalmers Company, 1906-8; Milwaukee Coke and Gas Company, 1908—.

LEON DOMINIAN. New York, N. Y.

(B. A., Roberts College, Constantinople, 1898; C. I. M. Mining School; University of Liege, 1900.)

Graduate Student, 1903-4. From Constantinople, Turkey. Assistant,

* Deceased.

U. S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-4; Engineer to Victor Fuel and Iron Company, Denver, Colorado, 1904-6; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-7; Consulting Engineer, Mexico City, Mexico, 1908-9; Consulting Engineer, New York, N. Y., 1910.

ROBERT CASIANO EATON.* Leon, Guanajuato, Mexico.

Student, 1893-4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1894-8; Superintendent, Mueriedas Smelting Works, Xichu, Guanajuato, Mexico, 1898; Superintendent, Pozo del Carmen Railroad, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager Nuevo Cinco Senores Mining and Milling Company, Comanja, Jalisco, Mexico, 1902-4; Independent Assayer and Ore Buyer in Leon, Gto., Mexico, since 1904.

ALEXANDER WALTER EDELEN. Angangueo, Michiocan, Mexico.

Student, 1905-6. From Baltimore, Maryland. Assistant Superintendent, Elkton Consolidated Mining and Milling Company, Elkton, Colorado, 1906; Superintendent Minas Bonanzas y Anexas, Zacatecas, Mexico, 1907-1909; Mine Superintendent, American Smelting and Refining Company, Angangueo, Michiocan, Mexico, 1909—.

THADDEUS BELL EVERHEART. Chloride, New Mexico.

Student, 1905-7. From Bells, Texas. Assayer and Surveyor, Pereguina Mining and Milling Company, Guanajuato, Mexico, 1907-8; Mill Superintendent, Las Animas Mining and Milling Company, Pueblo Nuevo, Durango, Mexico, 1909-10; Mining, Chloride, New Mexico, 1911—.

HARRY THORWALD-GOODJOHN. Torreon, Coahuila, Mexico.

Student, 1902-3. From Pittsburg, Texas. Assayer, Cia. Metalurgica del Torreon, State of Coahuila, Mexico, 1903-1906; Chief Chemist, Mapimi Smelter, 1906; Chemist and Metallurgist, Cia. Minera, Fundidora y Afinadora, Monterey, Mexico, 1907-8; Chief Chemist, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1909—.

SAMUEL JAMES GORMLEY. West Jordan, Utah.

Student, 1895-6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895-6; Assistant Assayer, Anaconda Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist to same company, 1900-2; Superintendent of Sampling Works, Washoe Smelting Company, Anaconda, Montana, 1902-6; Smelter Superintendent, Bingham Copper and Gold Mining Company, West Jordan, Utah, 1906.

RUE N. HINES. El Paso, Texas.

(B. S., New Mexico School of Mines, 1907.)

Student, 1904-7. From Socorro, New Mexico. Superintendent, West Coast Mining and Smelting Company, Mocorito, Sinaloa, Mexico, 1907-1909.

EDMUND NORRIS HOBART. Clifton, Arizona.

(B. S., New Mexico School of Mines, 1910.)

Student, 1906-8, 1909-10. From Clifton, Arizona. Chemist, Socorro Mines Company, Mogollon, New Mexico, 1909; Chief Sampleman, Shannon Copper Company, Clifton, Arizona, 1910—.

ANTON HOGWALL. Nogal, New Mexico.

Student, 1898-9. From White Oaks, New Mexico. Assayer, Buckeye Mining Company, Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Company, and Helen Rae Mining Company, White Oaks, New Mexico, 1901; Assayer, American Gold Mining Company, Nogal, New Mexico, 1902.

CARL JOHN HOMME. Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate Student, 1899-1900. From Wittenburg, Wisconsin. Assayer, and Chemist to Candelaria Mining Company, El Paso, Texas, 1900-01; Assistant Superintendent, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902.

WILLIAMS ELIAS HOMME. Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate Student, 1902-03. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. HOWELL. Tehuacan, Puebla, Mexico.

Student, 1900-1905. From Socorro, New Mexico. Civil Engineer on railway from Acapulco, Mexico, 1906-7; Civil Engineer, Mexican Central R. R., 1907—.

HARRY J. HUBBARD. Jocoro, San Salvador, Central America.

(B. S., New Mexico School of Mines, 1906.)

Student, 1905-6. From Bisbee, Arizona. Mine-foreman, Navidad Mine of Greene Gold-Silver Company, Concheno, Chihuahua, Mexico, 1906; Chemist, Navidad Mine of Greene Gold-Silver Company, 1906; Assistant Mill Superintendent, Sahuauycan Mining Company, Sahuauycan, Chihuahua, Mexico, 1906; Machine Drill Foreman, Sirena Mine Guanajuato, Mexico, 1907; Shift-boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan and Associates, in southern states of Mexico, 1907; Tramway Superintendent, Minas Bonanzas y Anexas, Bonanza, Zac., Mexico, 1908; Mine-foreman, Butters Divisavero Mines, Jocoro, San Salvador, Central America, 1909—.

JOHN AUGUST HUNTER. Los Angeles, California.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-4; Chemist and Metallurgist, American Smelting and Refining Company, Aguas Calientes, Mexico, 1904-8; Metallurgist, Congress Mining Company, Congress, Arizona, 1909-10; Assayer, Los Angeles, California, 1910.

CHARLES THAYER LINCOLN. Brooklyn, New York.

(S. B., Massachusetts Institute of Technology, 1901.)
Graduate Student, 1902-3. From Boston, Massachusetts, Chemist to American Bell Telephone Company, Boston, Massachusetts, 1901-2; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-3; Acting Professor, same, 1903-4; Instructor in Chemistry, Iowa State University, Iowa City, 1904-5; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-7; Chemist, Arbuckle's Brothers Sugar Refinery, Brooklyn, New York, 1907—.

FRANCIS CHURCH LINCOLN. Butte, Montana.

(S. B., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1902.)
Assayer to San Bernardo Mining and Milling Company, 1900; Chemist to Butterfly Terrible Gold Mining Company, 1900-1; Professor of Metallurgy, New Mexico School of Mines, 1902-4; Assistant Superintendent, Ruby Gold and Copper Company, Ortiz, State of Sonora, Mexico, 1904; General Manager, Arizona Gold and Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907—.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer with Illinois Steel Company, 1900.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University; M. D., Bellevue Hospital.)
Graduate Student, 1900-1. From New York City, 136 Fifth Avenue, New York City, 1901.

DANIEL M. MILLER. Lake Valley.

(B. S., New Mexico School of Mines, 1909.)
Student, 1906-9. From Lake Valley, New Mexico.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899-1900. From Santa Ana, California, County Surveyor, Orange County, California, 1900-1. Assistant Engineer, Temescal Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Company, 1901-2; Assistant Engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

ERLE D. MORTON. Los Angeles, California.

(E. M. in Geology, New Mexico School of Mines, 1909.)
Student, 1903-5,- 1908-9. From Los Angeles, California. Assistant Superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-6; Washington University, 1906-7; Mine Examiner, Los Angeles, California, 1907-8; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908; Mine Superintendent, Arizona and Nevada Copper Company, Luning, Nevada, 1909-10; Mining Engineer, Los Angeles, California, 1910—.

WILLIAM FREDERICK MURRAY. Hastings, Colorado.

Student, 1904-6. From Raton, New Mexico. In Chief Engineer's Office of the Victor Coal Company, Denver, 1906-7; Assistant Engineer, Victor Fuel Company, 1907-8; Assistant to Chief and Traveling Engineer, Victor Fuel Company, and Colorado and South(Eastern Railway Company, 1908; Assistant Superintendent, Hastings Mine, Victor Fuel Company, Hastings, Colorado, 1909—.

PATRICK J. O'CARROL.*

(B. A., University of Dublin, Ireland.)

Graduate Student, 1898-9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896; Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

JUAN PALISSO. Mexico.

Student, 1903-4. From Barcelona, Spain. Mining Engineer, Mexico.

ORESTE PERAGALLO. Socorro, New Mexico.

(E. M., New Mexico School of Mines, 1908.)

Student, 1907-8. From Ciudad Juarez, Chihuahua, Mexico. Mining Engineer, El Paso, Texas, 1908-10; Graduate student, New Mexico School of Mines, 1910-11.

FOUNT RAY. Italy, Texas.

Student, 1901-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Company, Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902.

ALBERT BRONSON RICHMOND. Tucson, Arizona.

Student, 1900-1. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gairlon, Sonora, Mexico, 1901-2; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and Metallurgist, Patagonia, Arizona; General Manager, Mansfield Mining and Smelting Company, Safford, Arizona, 1908; Consulting Engineer, Tucson, Arizona, 1909—.

DELL FRANK RIDDELL. Parral, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; M. E., New Mexico School of Mines, 1905.)

Graduate Student, 1903-5. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4; Acting Professor of Assaying, same, 1904-5; Holder of Allis-Chalmers Scholarship, 1905-6; Engineer Universam Pump and Manufacturing Company, Kansas City, Missouri, 1906-7; Superintendent, Benito Juarez Mine, Parral, Chi-

* Deceased.

huahua, Mexico, 1907-8; Consulting Engineer and Acting Superintendent, Providentia Mines Company, Parral, Chihuahua, Mexico, 1908.

ORLANDO DOUGLAS ROBBINS. Santa Rita.

(E. M., New Mexico School of Mines, 1909.)

Student, 1905-9. From Louisville, Kentucky. Chemist, Santa Rita Mining Company, Santa Rita, New Mexico, 1909-10.

WILLIAM CARLOS STEVENSON.* Redlands, California.

Student, 1900-1. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1903-4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1902.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

(B. S., in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)

Student, 1895-6. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate Student, Johns Hopkins University, 1897-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1903-4. From Peoria, Illinois. Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Bellingham, Washington.

(B. S., M. S., University of Illinois; LL. B., University of Michigan; A. M., Ph. D., Columbia University.)

Graduate Student, 1901-2. Mining Lawyer, Bellingham, Washington.

OLIVER RUSSELL SMITH. Zillah, Washington.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1898; C. E., New Mexico School of Mines, 1903.,

Graduate Student, 1899-1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1; Instructor in Engineering and Drawing, New Mexico School of Mines, 1901-2; Assistant Professor in Engineering and Drawing, New Mexico School of Mines, 1902; Assistant Survey, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902; Deputy Mineral Surveyor, U. S. Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1902-7; Civil Engineer, Santa Fe R. R., San

* Deceased.

Bernardino, California, 1907-8; Engineer, United States Reclamation Service, Zillah, Washington, 1908-10.

OTTO JOSEPH TUSCHKA. Monterey, Mexico.

(E. M., in Metallurgy, New Mexico School of Mines, 1897.)

Student, 1893-7. Assayer and Chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-8; Graduate Student, New Mexico School of Mines, 1898-9; Assistant Sampling Mill Foreman and Chemist, Guggenheim Smelting and Refining Company, Monterey and Aguas Calientes, Mexico, 1899-1900; Assayer, Seaman Assay Laboratory, El Paso, Texas, 1900;! Chief Chemist, Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

MILTON BENHAM WESTCOTT. Monterey, Mexico.

Student, 1904-5. From Chicago. Engineering Corps, Santa Fe Railroad, 1905; Assistant County Surveyor, El Paso County, 1906-7; Assistant Engineer, Monterey Railway, Light and Power Company, Monterey, Mexico, 1907; Assistant Engineer, Monterey Waterworks and Sewer Company, 1907-8; Resident Engineer, Monterey Water Works and Sewer Company, 1908.

PATRICK ANDREW WICKHAM. Maris, Chihuahua, Mexico.

Student, 1893-4. From Socorro,- New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Company, and Albemarle Mining Company, Bland, New Mexico, 1898-9; Mechanical Engineer, Mt. Beauty Mining Company, Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Company, Cripple Creek, Colorado, 1900-1; Foreman, Guggenheim Exploration Company, Minas Tecolotes, Santa Barbara, Mexico, 1901-2; Foreman, Independence Consolidated Gold Mining Company, Cripple Creek, Colorado, 1902-4; Manager, Consuelo and Esperanza Gold Mining Companies, Dolores, Mexico, 1904-6; Assistant Superintendent, Kelvin-Calumet Copper Mining Company, Ray, Arizona, 1907-8; Superintendent, La Cienega Mining Company, Maris, Chihuahua, Mexico, 1909—.

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.

Student, 1893-4. From Council Bluffs, Iowa. Assistant Superintendent and Metallurgist, Granby Consolidated Mining, Smelting- and Power Company, Limited, Grand Forks, B. C., 1898; at present Superintendent of the same.

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ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1911--1912

WITH ANNOUNCEMENTS FOR 1912-13

SANTA FE, N. M.
NEW MEXICAN PRINTING COMPANY
1912

MAIN BUILDING.

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CALENDAR.

1912-1913.

First Semester:

September 9, Monday—Registration of students.

November 28 and 29, Thursday and Friday—Thanksgiving recess.

December 22—Christmas vacation begins.

January 6, Monday—Work resumed.

January 13-16, Monday-Thursday—Examinations.

Second Semester:

January 17, Friday—Registration of students.

May 12-15, Monday-Thursday—Examinations.

May 16, Friday—Commencement.

FACULTY.

EMMET ADDIS DRAKE................*President of the Faculty.*
A. B., Wisconsin University, 1882; A. M., 1887.

GEORGE IRVING KEMMERER,.............*Professor of Chemistry.*
A. B., Wisconsin University, 1904; A. M., 1906; Ph. D., University of Pennsylvania, 1908.

BYRON KEMP COGHLAN *Professor of Civil Engineering.*
B. S., University of Illinois, 1908.

GUSTAVUS EDWIN ANDERSON, *Professor of Geology and Mineralogy.*
S. P., University of Chicago, 1905; A. M., Columbia University, 1906.

JOHN FRASER GRAHAM,.....*Professor of Mining and Metallurgy.*
B. S., Michigan College of Mines, 1905.

THOMAS CALVIN MACKAY,............*Professor of Mathematics.*
A. B., Dalhousie University, 1893; A. M., Harvard University, 1898; Ph. D., 1903.

EDWARD A. WHITE,.......*Instructor in Mechanical Engineering.*
B. S., University of Kansas, 1908.

CARL CLYDE SMITH,.................*Principal of the Academy.*
Ph. B., Ohio State University, 1890.

ANNE W. FITCH,...................................*Registrar.*

NEW MEXICO SCHOOL OF MINES.

HISTORICAL SKETCH.

The New Mexico School of Mines was founded by act of the Legislature of 1889. The act provided for the support of the School by an annual tax of one-fifth of a mill on all taxable property.

Under an act of the Legislature, approved February 28, 1891, a board of trustees was appointed. Organization was effected and immediate steps were taken towards the erection of necessary buildings. In the same year a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892 a circular of information regarding the New Mexico School of Mines at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land fifty thousand acres for its support and maintenance. From this source of revenue the School has already received more than $17,000.

In 1899 the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901 the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grant of lands in order to more thouroughly equip the School with buildings and apparatus.

In 1903 the Thirty-fifth General Assembly raised the millage to forty-five one-hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

Since 1903 the appropriation for the support and maintenance of the School of Mines has been increased at each session of the General Assembly. At the last session the appropriation was raised to $19,000 a year.

By the terms of the Enabling Act under which New Mexico was admitted to statehood, the School of Mines becomes possessed of 150,000 acres of land. This generous appropriation will, it is believed, soon be the source of a very considerable revenue to this institution.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees

and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said school require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico School of Mines is located at Socorro, the county seat of Socorro county, on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Re railway starts from this place.

Socorro is situated in the valley of the Rio Grande at the foot of the Socorro range of mountains at an elevation of 4,600 feet above the level of the sea. The surrounding scenery is diversified by plains, valleys, mesas, hills, and mountains. The climate of the locality is pre-eminently pleasant and healthful, and has long attracted health-seekers who would escape the rigors of less favored localities. The air is exceedingly dry and the temperature is mild and equable. Socorro's public water supply comes from warm springs that issue from Socorro mountain three miles away. The water is famed for its purity and has always been an attraction to visitors and residents.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed . The industrial

processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Deming, Fierro, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, smelting, lixiviation, cyaniding, and other metallurgical processes.

A number of mines of various kinds, smelters, irrigating systems, and other engineering works are accessible to the School. Within a few hours' ride by rail are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years they have yielded their wealth to the Europeans and centuries before his advent gave up even greater treasures to the native races.

The history of modern mining schools shows that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of the world.

The School is a state institution. It was established primarily to promote the development of the mineral resources of New Mexico and to provide facilities for the young men of the state to secure a practical education in all departments of mining. Naturally, however, the institution's field of usefulness has steadily grown broader. Not only New Mexico but also other parts of the southwest have felt its influence through its graduates in the development of the mining industries of this great region. Moreover, a considerable number of students from other parts of the country who desired to avail themselves of the peculiar advantages of this region have come to the School of Mines for the training they needed and the number of such young men is constantly increasing.

During the entire period of his training the fact is impressed upon the mind of the student that intelligent mining is a business

operation capable of being put on as secure a foundation as any other, that from beginning to end it is akin to all other great business undertakings, that while lucky finds will doubtless continue to be made mining is no longer to be considered a mere lottery appealing to the gambling propensities.

During the past quarter of a century the development of the mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surroundings of the School already described create an invigorating mining atmosphere which is entirely wanting in situations remote from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in those technical institutions of learning where all practical branches are equally represented, singleness of purpose is a leading feature of the New Mexico School of Mines. The conservation of energy growing out of the special method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect under the direct supervision of his instructors various plants and works and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologic-

ally than any other section of the United States. A little study of the plateau region of the northwestern portion of the state has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made under government auspices to investigate closely the geological structure of New Mexico mountains such as have been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

Much of the advanced professional work of the School is of an original nature to the end that the graduates may be skilled, theoretically and practically, in the very problems which they as professional men will be called upon to solve. This work is carried on by the advanced students under the direction of the professors and involves the collection of notes, sketches, maps, and specimens, and the results of directed observations in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining and in the reduction of the ores of lead, silver, gold, and copper are so numerous that it is impossible to do more here then to mention the fact that the conditions of climate, drainage, water-supply, and geological structure in New Mexico differs greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigations of the ores of iron, manganese, aluminum, cobalt, nickel, tin, and quicksilver, together with the beds of coal, salt, alum, building stones, mineral-paints, cement-rocks, marls, etc., are directly in line with the advanced laboratory work of the School, and every student who undertakes such work is encouraged in every possible way to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the State with the concurrence of the Council for a term of four years. The Board of Trustees elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them.

By act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of

the state. The New Mexico School of Mines, therefore, is composed of the College and the Academy.

THE COLLEGE.

The Requirements for Admission.

Candidates for admission to the College are required to present a statement from some school of recognized standing certifying that they have completed and received a passing grade in the following subjects: Arithmetic, Elementary Algebra, Plane and Solid Geometry, ninth and tenth grade English, and one year of Elementary Physics. Those candidates who are unable to present such a statement may take an examination by the Principal of the Academy on any of the foregoing subjects to determine their proficiency therein.

Registration.

No student will be allowed to register for any subject until the pre-requisites are credited to him on the school records. Therefore the student is advised not to delay either in making up any deficiencies which may exist or in obtaining from the School the credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided, that no more than the first two years of the curriculum be thus credited to a student who has not yet received the bachelor's degree, and provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the engineer's degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time or matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institu-

tion come prepared to take up the work without conditions. Every candidate for admission to the School may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students desiring to take special courses without a view to graduation may do so provided that they give evidence of proficiency in the prerequisite subjects and that their taking such courses does not interfere with the regular schedule of classes.

Curricula.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining and metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:
MINING ENGINEERING, MINING GEOLOGY, METALLURGICAL ENGINEERING, AND CIVIL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of either of them, the Bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines who have spent two years in professional work, at least one of which must have been in a position of responsiblity, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours' work in the field or in the laboratory. In the following outlined statement of curricula the number of hours per week required in the class-room and in the field or in the laboratory are given separately. The number of hours required in the field or in the laboratory represents *average* time, however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

UNIFORM CURRICULUM FOR THE FIRST YEAR.

The curriculum for the first year of the four courses offered at the School of Mines is the same in all respects. This arrangement is of advantage to the student, for it gives him until the beginning of the second year to determine for which of the four courses he is best fitted by inclination or aptitude.

Mathematics, physics, and chemistry are fundamental subjects for the successful engineer. For that reason the first year of all the engineering courses is devoted to a thorough grounding in those three subjects, as will be seen in the tabular statement below. Specialization does not begin until afterwards.

Excellent facilities are offered for the acquisition of a thorough knowledge of these subjects so necessary to successful engineering work both during the remainder of the course and during a professional career. The physical labortory is well equipped with such apparatus as present-day requirements demand, and the chemical laboratories are fitted up in a manner that leaves little to be desired for comfort, convenience, or efficient work.

FIRST YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y.
		First Semester.		
I.	1.	Advanced Algebra	3	
I.	2.	Trigonometry	5	
I.	3.	Analytic Geometry	2	
III.	1.	General Chemistry	6	6
IV.	1.	Mechanical Drawing and Lettering		9
IV.	3.	Descriptive Geometry	2	
		Second Semester.		
I.	1.	Advanced Algebra	5	
I.	2.	Trigonometry	1	
I.	3.	Analytic Geometry	4	
III.	2.	Qualitative Analysis	1	9
IV.	2.	Mechanical Drawing and Lettering		6
IV.	4.	General Surveying	3	4

MINING ENGINEERING.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valueing property, properly reporting propositions submitted for investment, calculating the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaptation of the steam shovel and stripping methods to western metal mines are treated at considerable length.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives detailed consideration.

FIRST YEAR,

See Page 15.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class	Lab'y.
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Physics I	3	3
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Physics II	3	3
III.	4.	Ore Analysis	1	9
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
II.	4.	Mechanics	4	
III	5.	Fuel Analysis		3
IV.	11.	Engines and Boilers	5	
V.	4.	Field Geology		8
V.	5.	Economic Geology	3	
VI.	1.	Mining A	3	3
VII.	2.	Metallurgy	3	2
		Second Semester.		
II.	4.	Mechanics	4	
IV.	9.	Strength of Materials	5	
IV.	12.	Machine Design	2	6
V.	6.	Economic Geology	3	
VI.	2.	Mining B	3	
VII.	1.	Fire Assaying	1	8

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
IV.	10.	Hydraulics	3	
IV.	22.	Mine Constructions	3	9
V.	7.	Petrology	2	3
VI.	3.	Mine Economics	3	
VI.	4.	Ore Dressing	3	
VI.	6.	Design of Mine Plant		3
VII.	5.	Metallurgy of Copper	2	
		Second Semester.		
IV.	22.	Mine Constructions	2	9
V.	7.	Petrology	2	3
VI.	4.	Ore Dressing	2	
VI.	5.	Air Compression and Pumping	3	
VI.	6.	Design of Mine Plant		6
VI.	7.	Mine Administration and Accounts	2	
VI.	8.	Examination of Mines	1	3

METALLURGICAL ENGINEERING.

The aim of this four years course is to train the student for a professional career in any branch of metallurgical work. Attention is given during the first two years to such fundamental subjects as mathematics, chemistry, physics, geology, mineralogy and preliminary courses in engineering. Instruction in metallurgy proper begins in the third year, both lectures and laboratory experiments being employed for the purpose. Chemistry and geology are provided for, also. The work of the fourth year is along the line of advanced courses in metallurgy, especial attention being given to laboratory experiments, high temperature conditions of metallurgy, training in execution, and interpretation of results. Such higher branches of engineering, chemistry, and courses of importance in mining engineering claim a considerable share of attention.

The course has been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals.

FIRST YEAR,

See Page 15.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Physics I	3	3
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2,	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II,	2.	Physics II	3	3
III.	4.	Ore Analysis	1	9
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
II.	4.	Mechanics	4	
III.	5.	Fuel Analysis		3
III.	8.	Electro-Analysis	1	6
IV.	11.	Engines and Boilers	5	
V.	5.	Economic Geology	3	
VI.	1.	Mining A	3	3
VII.	2.	Metallurgy	3	2
		Second Semester.		
II.	4.	Mechanics	4	
IV.	9.	Strength of Materials	5	
IV.	12.	Machine Design	2	6
V.	6.	Economic Geology	3	
VII.	1.	Fire Assaying	1	8
VII.	3.	Furnaces	3	

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class	Lab'y.
		First Semester.		
III.	13.	Electro-Metallurgy	2	3
IV.	10.	Hydraulics	3	
IV.	22.	Mine Constructions	3	9
VI.	4.	Ore Dressing	3	
VII.	4.	Metallurgy of Lead	3	
VII.	5.	Metallurgy of Copper	2	
VII.	9.	Metallurgical Plant and Design	1	3
		Second Semester.		
IV.	22.	Mine Constructions	2	9
VI.	4.	Ore Dressing	2	
VI.	7.	Mine Administration and Accounts	2	
VII.	6.	Metallurgy of Gold and Silver	3	
VII.	7.	Matallurgy of Iron and Steel	3	
VII.	8.	Metallurgical Laboratory	1	8
VII.	9.	Metallurgical Design		6

MINING GEOLOGY.

This course extending over a period of four years is intended primarily to train men to examine, report and direct the future development of mines. In the first two years the course prescribed is similar to that of the Mining Engineering Department, so that students have a thorough training in fundamental subjects, especially in mathematics, chemistry, surveying, and other preliminary courses in engineering. In the third year the attention of the student is directed largely to geological subjects related closely to mining, namely, topographical surveying, geological surveying, petrology, and economic geology, while still continuing his studies in chemistry, mining, metallurgy, etc. The fourth year is devoted largely to advanced work in mining geology, visiting and reporting in detail on geological problems connected with ore deposition in various mining fields. Attention also is paid to the geological occurrence of petroleum.

FIRST YEAR.

See Page 15.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y.
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Physics I	3	3
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Physics II	3	3
III.	4.	Ore Analysis	1	9
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week	
			Class.	Lab'y.
		First Semester.		
II.	4.	Mechanics	4	
III.	5.	Fuel Analysis		3
III.	7.	Advanced Quantitative Analysis	1	6
V.	4.	Field Geology		8
V.	5.	Economic Geology	3	3
VI.	1.	Mining A	3	3
VII.	2.	Metallurgy	3	2
		Second Semester.		
II.	3.	Light	1	
II.	4.	Mechanics	4	
III.	7.	Advanced Quantitative Analysis		6
V.	6.	Economic Geology	3	3
VI.	2.	Mining B	3	
VII.	1.	Assaying	1	8

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y.
		First Semester,		
III.	12.	Physical Chemistry	2	
IV.	10.	Hydraulics	3	
V.	7.	Petrology	2	6
V.	9.	Ore Genesis		6
VI.	3.	Mine Economics	3	
VI.	4.	Ore Dressing	3	
VI.	6.	Design of Mine Plant		3
		Second Semester.		
V.	7.	Petrology	2	6
V.	8.	Geological Examination and Surveys	2	
V.	10.	Paleontology	2	6
V.	11.	Special Problems		5
VI.	5.	Air Compression and Pumping	3	
VI.	6.	Design of Mine Plant		6
VI'	7,	Mine Administration and Accounts	2	
VI,	8.	Examination of Mines	1	3

CIVIL ENGINEERING.

This department provides a course of study in the theory and application of the principles of civil engineering. The first two years of work are substantially the same as in the other engineering courses, including practical work in drafting room and field, as well as instruction in the fundamental principles of mathematics and physics. In the third year the studies relate more directly to civil engineering. Technical courses cover the principles of structural and machine design, power and power transmission, and other fundamental engineering processes. In the drafting room the student applies those principles to the design of machines, and bridge and roof trusses. Sufficient field work is given to make the student thoroughly familiar with surveying instruments, and their use in road, mine, and railroad surveys.

FIRST YEAR,

See Page 15.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y.
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Physics I	3	3
III.	3.	Quantitative Analysis	1	6
IV.	5.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Physics II	3	3
III.	4.	Ore Analysis	1	9
IV.	6.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
II.	4.	Mechanics	4	
IV.	7.	Railway Location	3	8
IV.	8.	Roads and Pavements	3	
IV.	11.	Engines and Boilers	5	
V.	5.	Economic Geology	3	
		Second Semester.		
II.	4.	Mechanics	4	
III.	7.	Advanced Quantitative Analysis		6
IV.	9.	Strength of Materials	5	
IV.	12.	Machine Design	2	6
IV.	13.	Graphics	2	
V.	6.	Economic Geology	3	

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y.
		First Semester.		
III.	5, 6.	Water and Fuel Analysis		6
IV.	4.	Hydraulics	3	
IV.	15.	Stresses	3	
IV.	16.	Structural Details		9
IV.	17.	Water Supply Engineering	5	
IV.	18.	Masonry	5	
		Second Semester.		
IV.	14.	Railroad Track, Yards, Structures	3	
IV.	15.	Stresses	3	
IV.	16.	Structural Details		9
IV.	19.	Contracts and Specifications	2	
IV.	20.	Sewerage and Drainage	5	
IV.	21.	Concrete Structures	3	

DEPARTMENTS OF INSTRUCTION.

1. DEPARTMENT OF MATHEMATICS.

DOCTOR MACKAY.

The study of mathematics is emphasized as a necessary basis for the further instruction in the engineering subjects. The courses have been arranged to meet the extensive needs of students in the various branches of engineering and are intended to develop power of deducation as well as to familiarize the student with the various methods of calculation used in practical problems. Students are encouraged to use logarithms and the slide rule when the latter can be employed without too great loss of accuracy. They will also be introduced to the books of tables that facilitate calculation.

1. Advanced Algebra.

The work begins with a review of elementary algebra. This is followed by the solution of simple and quadratic equations with a large number of practical problems, the summation of arithmetical and geometrical progressions, graphical solutions of equations, vector qualities, variation and proportion, partial frictions, logarithms, inequalities, probability, abridged methods of calculation, slide rule, and limits of error.

Prerequisites: *Elementary Algebra.*

Time: Class room, three hours a week, first semester; five hours a week, second semester.

Text: Hawkes, *Advanced Algebra.*

2. Trigonometry.

A thorough knowledge of the subject matter of this course is essential for the successful carrying out of general surveying, topographic surveying, and mine surveying. It deals with the measurement of angles; the relations among the sine, cosine, and tangent of an agle; the values of the functions of multiple and fractional angles; solution of simple trigonometric equations; the solution of right and oblique triangles, involving logarithmic calculations with tables and very many practical problems; the simplest elements of spherical trigononmetry. The last mentioned

subject is necessary for an understanding of the methods of determining latitude and longitude, and also is essential for geodetic surveying.

Prerequisites: Elementary Algebra and Plane and Solid Geometry.

Time: Class-room, five hours a week, first semester; one hour a week, second semester.

Text: Granville, *Plane and Spherical Trigonometry with Tables.*

3. Analytic Geometry.

This subject combines the methods used in algebra and in geometry and employs them in the study of simple curves, surfaces and solids. It therefore affords a very good introduction to mechanical drawing, mapping, surveying, and mensuration. It deals with plotting with different systems of co-ordinates, estimation of areas, properties of systems of straight lines, circles, the parabola, the ellipse, the hyperbola, changes produced in maps by change of origin and rotation of axes, simple curves in three dimensions, surface areas and volumes of simple solids.

Prerequisites: Courses 1 and 2 of this department must accompany or precede this course.

Time: Class-room, two hours a week, first semester; four hours a week, second semester.

Text: Smith and Gale, *Introduction to Analytic Geometry.*

4. Differential Calculus.

This subject is of great importance in the study of curves, of rates of variation, of maximum and minimum values and is indispensable for the reading of most text-books of science, especially as applied in text-books on engineering. It includes limits, curve tracing and other applications of the derivative, maxima, and minima, radii of curvature, summation of series, partial differentiation, solution of many problems on least cost and maximum efficiency.

Prerequisites: Courses 1, 2, and 3 of this deparement.

Time: Class-room, five hours a week, first semester.

Text: Granville, *Elements of Differential and Integral Calculus.*

5. Integral Calculus.

The integral calculus is the most powerful weapon of calculation. It is applied in this course to the calculation of lengths of

curves, areas of surfaces, volumes of solids, moments of inertia, centers of gravity, work performed by bodies moving against given forces, and many other applications to mechanics, heat, electricity and magnetism, and mensuration.

Prerequisites: Courses 1, 2, 3, and 4 of this department.
Time: Class-room, five hours a week, second semester.
Text: Granville, *Elements of Differential and Integral Calculus.*

SPECIAL AND GRADUATE COURSES IN MATHEMATICS.

Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work. The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in mathematical investigation of problems of engineering or applied science. The idea that an engineer should be a practical rather than a theoretical mathematician has guided the selection of elective and graduate courses. Students who wish to take optional work should arrange at the beginning of the college year with the head of the department of mathematics.

In addition to the foregoing, which are required of all students of engineering, the following elective and graduate courses are offered:

6. Integrals of Mechanics.

Certain types of integrals which are met with great frequency in the study of mechanics, are treated. Those integrals, namely, the inertia integrals, those defining mass, and moment and center of mass, are essential in the discussion of the motion and the conditions of equilibrium of systems of particles, and rigid bodies. Other integrals are studied, mechanics applications to work, attraction, pressure, and centers of gravity and pressure.

Text: Lester, *The Integrals of Mechanics.*

7. Applications of the Calculus to Mechanics.

Wherever the teaching of mathematics to engineering students is discussed, and frequently in cases of other classes of students, the criticism which is almost without exception the most insistent is this: that the student leaves the course without adequate ability to *apply* his mathematical knowledge. This means that he has not the faculty of taking a problem, giving it an analytic formulation,

and interpreting the analytic results. This course is to supply the needed training. Students should obtain a comprehensive view of this course, partly because of the value of such a course as a means of general mental development, partly because new practical applications of discoveries in engineering are continually being made, and no one can predict what particular facts or principles are most likely to find important practical applications in the future.

Text: Hedrick & Kellogg, *Applications of the Calculus to Mechanics.*

8. Differential Equations.

In many Colleges of Engineering, the need is felt for a course treating the subject of Differential Equations, limited in scope yet comprehensive enough to furnish the student of engineering with sufficient information to enable him to deal intelligently with any differential equation which he is likely to encounter. To meet this need is the object of this course. This course will be found to be complete in all those portions which bear upon practical applications. Numerous applications to problems in Geometry, Physical Sciences, and Engineering are introduced.

Text: Cohen, *An Elementary Treatise on Differential Equations.*

DEPARTMENT OF PHYSICS AND MECHANICS.

Physics.

DOCTOR MACKAY.

The courses in physics outlined below are intended to introduce the student to accurate measurements identical with or similar to those which he will have to perform frequently as an engineer. They will also help to give him a rational basis for understanding very many of the processes that he has to use in furnace work, the management of steam-engines, water motors, dynamos, etc., and in general help him to understand the physical bases for the varied procedures in all practical processes.

1. Mechanics, Molecular Physics, and Heat.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Pressure-expansion of gases; (14) Heat-expansion of gases; (15) Archimedes' principle; (16) Calorimetry; and a few other exercises if time permits.

This course is intended not only to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained, but also to give him a better understanding of the laws of physics and of the real significance of physical constants.

Prerequisite: Course 2 of Department 1.

Time: Class-room, three hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Millikan, *Mechanics, Molecular Physics and Heat.*

2. Electricity and Magnetism.

This course deals with the elementary principles of electricity, magnetism, and the practical application of the same in dynamos, motors, lamps and electric furnaces. Qualitative experiments are performed in the lecture-room to illustrate the principal phenomena of this very large and fruitful subject. Quantitative experiments are performed in the laboratory in order to make the electrical and magnetic quantities as much as possible real quantities in the experience of the student.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Texts: Thompson, *Elementary Lessons in Electricity and Magnetism.* MacKay, *Physical Measurement.*

3. Light.

This course is offered to those students who wish to study the principles that govern the construction of the optical instruments used in surveying, mineralogy, and petrography. The lectures will deal with the reflection, refraction, and differentiation of light, polarized light, eye-pieces, objectives, prisms, polarizers, analyzers, etc.

Time: Class-room, one hour a week, second semester.

Texts: *Ames on Light.*
MacKay, *Physical Measurements.*

MECHANICS.

This is such a fundamental subject in the studies of an engineering student that it cannot be sufficiently treated in any one course or department. The course indicated below is intended to complete the work in mechanics begun in physics I am to serve as an introduction to courses in other departments in strength of materials, graphic statics, hydraulics, etc.

4. Mechanics.

The principal topics taken up are force, combinations of forces, center of gravity, moment of inertia, gravitation, stress, numerous cases of equilibrium, cords, jointed frames, friction, velocity and acceleration, harmonic motion, translation, rotation, work, energy,

impulse, momentum, and very many simple practical problems with different forms of structures and machines.

Prerequisites: Courses 2, 3, 4, and 5 of Department I and Course 1 of this department.

Time: Class-room, four hours a week, one year.

Texts: Maurer, *Technical Mechanics.*
Sanborn, *Mechanics Problems.*

III. DEPARTMENT OF CHEMISTRY.

DOCTOR KEMMERER,
C. J. NEEL, Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

It is the intention to secure as perfect a correlation as possible between the lectures, the quizzes, and the laboratory-work, in order that the greatest efficiency in instruction may be attained.

1. Elements of Chemistry.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common elements.

The class-room work consists of lectures in which the chemistry of the elements and their compounds is simplified as much as possible. The more important reactions and theories are illustrated with lecture-table experiments and immediately following the class-room work each student performs as many experiments as possible in the laboratory, carefully recording the results. These records are then corrected by the instructor and returned to the student. Twice each week the students are quizzed on both the class-room and laboratory work and once each month the work is reviewed in a written test.

Time: Class-room, six hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Kahlenberg, *Outlines of Chemistry.*
Kahlenberg, *Laboratory Exercises in General Chemistry.*

2. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper group are analyzed. In this manner the metals of all the groups and finally the acids are studied. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze several of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisite: Course 1 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. I.*
Baskerville & Curtman, *Qualitative Analysis.*

3. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

The gravimetric determination of chlorine in a soluble chloride; water of crystallization in copper sulphate; iron and sulphur in ferrous or ferric sulphate; carbon dioxide, calcium, and magnesium in dolomite; silver and copper in a dime; tin, lead, copper, and zinc in a bronze; and silica in an insoluble silicate.

The class-room work consists of lectures and quizzes in which the various anaytical processes are studied from the standpoint of modern chemical theories.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. II.*
Fresenius, *Quantitative Chemical Analysis.*

4. Ore Analysis.

A thoroughly practical course in the determining of the important constituents of ores and metallurgical products. The methods

taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products.

Each student is required to analyze two or more ores for each of the following: Iron, copper, zinc, lead, phosphorus, calcium manganese, and silica.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Texts: Low, *Technical Methods of Ore Analysis.*
Sutton: *Volumetric Analysis.*

5. Fuel Analysis.

Analyses of various coals and other fuels are made, their heat-values calculated from these analyses and also determined by means of the calorimeter. Flue-gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

6. Water Analysis.

Analyses of waters are made in regard to their possible use in boilers. These analyses involve determination of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 3 of this department.

Time: Laboratory, last ten weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Fresenius, *Quantitative Chemical Analysis.*

7. Advanced Quantitative Analysis.

This course is a continuation of Course 3 or 4. It may be substituted for Course 8. The work will be chosen to suit the needs of each student. It may consist of the complete analysis of rocks and minerals, advanced ore analysis, iron and steel analysis, cement analysis, or the determination of some of the rare elements.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, one semester.

8. Electro-Analysis.

This course will deal with the practical application of the electric current in determining some of the common metals such as copper, silver, lead, and zinc. After the student has become familiar with the methods used for determining each of these, he will use the current in separating mixtures of metals and as a rapid, accurate method of ore analysis.

The course may be substituted for Advanced Quantitative Analysis, Water and Fuel Analysis, or taken as a special.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, one semester.

Text: Edgar F. Smith, *Electro Analysis.*

9. Inorganic Preparations. (Special.)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 2 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, one semester.

10. Industrial Inorganic Chemistry. (Special.)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this man-

ner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become espceially interested.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one semester.

Text: Thorp, *Outlines of Industrial Chemistry.*

11. Organic Chemistry. (Special.)

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

12. Physical and Theoretical Chemistry.

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisite: Course 3 of this department.

Time: Class-room, two hours a week, first semester.

Texts: Ewell, *Physical Chemistry.*
Jones, *Elements of Physical Chemistry.*

13. Electro-Metallurgy.

The course is designed to furnish the student of metallurgy with a knowledge of the theoretical principle and practical application of the electric current as used in the extraction, production, and purification of metals and chemical compounds. Both electro-thermal and electrolytic processes are studied.

Prerequisite: Course 2 of Department VII.
Time: Class-room, two hours a week, first semester.
Laboratory, three hours a week, first semester.
Text: Thompson, *Applied Electro-Chemistry.*

14. Elements of Practical Photography. (Special.)

The course is planned to furnish the engineer with a working knowledge of photography such as will enable him to use the camera intelligently as an aid in his engineering work.

The class-room work will consist of one lecture a week which will be supplemented by laboratory work in which each student will be required to take and finish a good negative, velox print, platinum print, lantern slide, and bromide enlargement.

Time: Class-room, one hour a week, second semester.

IV. DEPARTMENT OF CIVIL ENGINEERING.

PROFESSOR COGHLAN,
MR. WHITE.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the work of the fourth year the student is given instruction in Structural, Sanitary, and Hydraulic Engineering. The work which is largely drawing and design, covers practical problems, with the intent that the student may become thoroughly familiar with the principles governing his profession and with their application.

The School offers great advantages in the line of Hydraulic and Irrigation Engineernig. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies.

1. Mechanical Drawing and Lettering.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented.

The latter part of the semester is devoted to special practice in lettering and free hand sketching.

Prerequisites: Entrance requirements.

Time: Laboratory, nine hours a week, first semester.
Texts: Anthony, *Mechanical Drawing.*
Reinhardt, *System of Lettering.*

2. Mechanical Drawing and Lettering.

A continuation of Course 1. Here the student makes working drawings from machine parts already made; first while having the part directly before him, and later from a free-hand sketch of the part, without having the latter to look at while drawing. He thereby becomes familiar not only with methods of dimensioning, laying out and reading working drawings but also those of making and using sketches. Through the entire course, particular stress is laid out neat lettering and symmetrical arrangement of drawings. The student is also taught tracing and blue printing.

Prerequisites: Course 1 of this department.
Time: Laboratory, six hours a week, second semester.
Text:

3. Descriptive Geometry.

The representation of all geometrical magnitudes by means of orthographic projection, the solution of problems involving points, lines, surfaces and solids, descriptions of and problems relative to warped and double-curved surfaces, intersections of lines and surfaces.

Prerequisites: Course 2 of Department I, and Course 1 of this department must precede or accompany.
Time: Class-room, two hours a week, first semester.
Text: Church, *Descriptive Geometry.*

4. General Surveying.

The introductory course in surveying deals with the principles of land measurement, and with the instruments used in both field and office.

In the class-room, the adjustments of the level and transit are taught, and the uses of these instruments in land surveying illustrated by practical problems.

In the field practice, each student becomes familiar with the use of the chain, tape, level, transit, etc.

Prerequisite: Course 2 of Department I.
Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.
Text: Johnson, *Theory and Practice of Surveying.*

5. Mine and Railroad Surveying.

The work consists of field work, recitations, and drafting room practice.

In the field work, a complete survey of a mining claim is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. In addition a complete survey of the underground excavations is made. Practice is also given in the laying out of railway curves and switches.

In the drafting room maps are made from the notes taken in the field practice. The value of careful work in the field and correct notes is thereby emphasized.

In the class-room, the principles of mining law are taught, and problems dealing with the connection of surface and subterranean workings are solved. The methods of computing and laying out railroad curves are studied.

Prerequisite: Course 4 of this department.

Time: Class-room, four hours a week, first semester.
Field, four hours a week, first semester.

Texts: Johnson, *Theory and Practice of Surveying.*
Allen, *Railway Curves.*

6. Topographical Surveying.

The theory and use of the stadia and other instruments used in making a topographic survey are considered, as are also the methods of topographic surveying. Some time is given to topographic drawing. A complete topographic survey based on a system of triangulation is executed, including the calculations, and platting and completing the map. Some attention is given to the precise measurement of bases and angles.

Prerequisites: Course 4 of this department.

Time: Class-room, two hours a week, second semester.
Field, four hours a week, second semester.

Text: Johnson, *Theory and Practice of Surveying.*

7. Railway Location.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length.

Prerequisites: Courses 4, 5 and 6 of this department.

Time: Class-room, three hours a week, first semester.
Field, eight hours a week, first semester.
Text: Wellington, *Economic Theory of the Location of Railways.*

8. **Roads and Pavements.**

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways; location, construction, drainage, improvement and maintenance of country roads; various paving materials,—broken stone, brick, asphalt, wood and stone blocks, and concrete; foundations for and adaptability of each; arrangement and details of city streets.

Prerequisite: Course 4 of this department.
Time: Class-room, three hours a week, first semester.
Text: Baker, *Roads and Pavements.*

9. **Strength of Materials.**

A study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to torsion, to compression, and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moment, slopes, and deflection; overhanging, fixed, and continuous beams, flat plates, and stresses in columns and in beams subjected to tension and compression as well as bending; torsional stresses; and stresses in spring.

Prerequisite: Course 4 of Department II must accompany or precede.
Time: Class-room, five hours, second semester.
Text: Merriman, *Strength of Materials.*

10. **Hydraulics.**

Under this head are treated fluid pressure, the principles of fluid equilibrium, and the laws governing the flow of water through orifices, over weirs, in closed conduits, and in open channels. The hydraulic laws relating to turbines and centrifugal pumps are briefly discussed, showing to what extent theory applies to these subjects.

Prerequisites: Course 4 of Department II and Course 9 of this department.
Time: Class-room, three hours a week, first semester.
Text: Merriman, *A Treatise on Hydraulics.*

11. Engines and Boilers.

In this course an elementary course in thermodynamics is given followed by the theory of the steam engine based on thermodynamics. This, in turn, is followed by a general descriptive course on engines and boilers, their types, details, construction and management. The whole course is supplemented by suitable problems to aid the student in his understanding and grasp of the subject.

Prerequisites: Courses 1 and 2 of Department II.
Time: Class-room, five hours a week, first semester.
Text: Kinealy, *Steam Engines and Boilers.*

12. Machine Design.

A study of the design of machine elements and modern machines, and of the nature, strength, and action under stress of the materials used in machine construction. Recitations are carried on, including the discussion of problems suitable for illustration of important points. In the drafting room each student completes the design of some specially assigned simple machine.

Prerequisites: Courses 1 and 2 of this department, course 9 of this department must precede or accompany.
Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second semester.
Text: Benjamin, *Machine Design.*

13. Graphic Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 4 of Department II.
Time: Class-room, two hours a week, second semester.
Text: Merriman and Jacoby, *Roofs and Bridges, Part II.*

14. Railroad Tracks, Yards, and Structures.

Instruction is given in the methods of proper location of railroad yards to insure efficiency of operation. The details of track construction are studied. Each student makes a drawing of some railroad structure, the dimensions being of his own measurement.

Prerequisite: Course 8 of this department.

Time: Class-room, four hours a week, second semester.
Text: Tratman, *Track.*

15. Stresses.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow, and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind, and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequsite: Course 9 of this department.
Time: Class-room, two hours a week, one year.
Text: Merriman & Jacoby, *Roofs and Bridges,* Parts I and IV.

16. Structural Details.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures. Each student makes a detailed design of a steel roof truss with its supporting columns, a plate girder bridge for railroad traffic, and a highway Pratt truss span.

Prerequisites: Course 9 of this department and Course 15 of this department must accompany.
Time: Laboratory, nine hours a week, one year.
Text: Merriman and Jacoby, *Roofs and Bridges,* Part III.

17. Water Supply Engineering.

The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, methods of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 10 of this department.
Time: Class-room, five hours a week, first semester.

18. Masonry.

The lectures treat chiefly of the following subjects:
(1) Materials used in masonry construction, under the heads

of stone, brick, lime, cement, wood, iron and steel. Special emphasis is placed upon the geological occurrences to the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe, and stone arches.

Prerequisite: Course 9 of this department.

Time: Class-room, five hours a week, first semester.

Text: Baker, *Masonry Construction.*

19. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, second semester.

Text: Johnson, *Engineering Contracts and Specifications.*

20. Sewage and Drainage.

A study of the quantity of house-sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 10 of this department.

Time: Class-room, five hours a week, second semester.

Text: Folwell, *Sewerage.*

21. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisites: Courses 15 and 18 of this department.

Time: Class-room, three hours a week, second semester.

22. Mine Constructions.

Under the head of Mine Construction, the application of the principles of Civil Engineering to the structures most frequently

required in mining is taken up. Mine buildings, bins, head-frames, trestles, crane-girders, fast-plants, tanks, etc., are studied as to form and materials of construction. The stresses produced in the members of these structures by the various kinds of loading, and the calculations of these stresses by algebraic and graphic methods are taken up.

In the laboratory the problems incident to design are solved and typical structures are designed and finished drawings made.

Prerequisites: Course 4 of Department II, and Course 9 of this department.

Time: Class-room, three hours a week, first semester.
Class-room, two hours a week, second semester.
Drafting-room, nine hours a week, first semester.
Drafting-room, nine hours a week, second semester.

Texts: Merriman and Jacoby, *Roofs and Bridges,* Parts I, II, and III.
Ketchum, *Walls, Bins, and Grain Elevators.*

V. DEPARTMENT OF MINING GEOLOGY.

Professor Anderson.

This department aims to give its students knowledge concerning bodies of ore and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditions, so that mining may become more and more a business and that the element of chance may be lessened.

1. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts, salts of the organic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 2 of Department III.

Time: Class-room, three hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Dana, *Text-Book of Mineralogy.*
Brush and Penfield, *Determinative Mineralogy and Blowpipe Analysis.*

2. General Geology.

All the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory work in the rock collections, and in study and interpretation of topographic maps, and frequent excursions into the field. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail, training in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Limitar mountain, ten miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Prerequisite: Course 1 of this department.
Time: Class-room, two hours a week, first semester.
Laboratory, three hours a week, first semester.
Text: Chamberlain and Salisbury, *College Geology.*

3. General Geology.

Discussion of theories of earth genesis, the principles of stratigraphy, and the geologic history of the development of the North American continent, involving laboratory work with type fossils and rock collections.

Prerequisite: Course 2 of this department.
Time: Class-room, three hours a week, second semester.
Text: Chamberlain and Salisbury, *College Geology.*

4. Field Geology.

Each student is assigned a limited area within the Socorro Quadrangle. Instruction is given in the field in observing and recording geological phenomena and the preparation of map and sections. The collections made are then studied in the laboratory and a complete report describing the geology of the area is required.

Prerequisites: Course 6 of Department IV and courses 1, 2, and 3 of this department.
Time: Saturdays, first semester.

5. Economic Geology.

This course embraces the study of the theories of ore deposition and the general features and formation of ore bodies and classifications of ore deposits. This is followed by a description of the deposits of the ores of iron, copper, lead, zinc, silver, gold, and the lesser metals, with special reference to North America.

Prerequisites: Courses 1, 2, and 3 of this department.
Time: Class-room, three hours a week, first semester.
Text: Kemp, *Ore Deposits of the United States and Canada.*

6. Economic Geology.

This course embraces the study of the non-metallic minerals of economic importance. A description of the distribution and oc-

currences of coal, petroleum, natural gas, asphalts, building stones, water supply, clays, cement rock, salt, gypsum, sulphur, fertilizers, abrasives, gems, and minor minerals.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three hours a week, second semester.

Collateral readings and reports on assigned topics are required of students in Mining Geology.

Time: Laboratory, three hours a week, one year.

7. Petrology.

A discussion of the origin, mineralogical and chemical composition, field classification and nomenclature, and microscopic structure of the crystalline, sedimentary, and metamorphic rocks. This is supplemented by field and laboratory work in the rock collections.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Kemp, *Handbook of Rocks and Lecture Notes.*
Luquer, *Rocks in Thin Sections.*

8. Geological Examinations and Surveys.

A discussion of the methods of systematically recording and interpreting geological phenomena, and the organization and scope of geological surveys. This is followed by a sketch of the history and results of state and national geological surveys in the United States, and of other sources of detailed information regarding local geology.

Prerequisites: Courses 1, 2, 3, 5, and 6 of this department.

Time: Class-room, two hours a week, second semester.

9. Ore Genesis.

The study of the paragenesis and origin of the minerals of a certain ore deposit. The student makes a collection of the deposit which is then studied in the laboratory by means of microscopic slides and polished surfaces and microchemical tests, etc.

Prerequisites: Courses 1, 2, 3, 4, 5, and 6 of this department.

Time: Laboratory, six hours a week, first semester.

10. Paleontology.

A study of the invertebrate index fossils characteristic of the geologic horizons of North America.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second semester.
Text: Grabau and Shimer, *North American Index Fossils.*

11. Special Problems.

Research work in some branch of the science of geology, such as investigation in petrology, stratigraphy, paleontology, or ore deposits. This work may form a basis of a thesis in Mining Geology.
Prerequisites: Courses 3, 5, 6, and 7 of this department.
Time: Laboratory, five hours a week, second semester.

VI. DEPARTMENT OF MINING ENGINEERING.

PROFESSOR GRAHAM.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. The entire course is pre-eminently practical in character.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Prospecting by panning, trenches, test pits, boring and drilling. Testing of placers and ore deposits with well or chain drills.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts; quarrying.

Machine drills: Construction and operation.

Tunnelling: Methods of driving and timbering; permanent linings; sizes, speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Methods of support: Pillars, timber, filling.

Excursions are made to neighboring mines on Saturdays.

Prerequisites: Courses 1, 2 and 3 of Department I; Courses 1 and 2 of Department II; Course 1 of Department III.

Time: Class-room, three hours a week, first semester.

Texts: Foster, *Elements of Mining and Quarrying.*
Lecture Notes.

2. Mining, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Ore extraction by systems of overhand and underhand stoping;

caving by top slicing and sub-drifting; support of workings by filling and square-setting.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives.

Hoisting: Engines, drums, wire rope, skips and cages; head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Arrangments at top and underground landings: Ore pockets; signalling, etc.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiencies of fans.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, three hours a week, second semester.

Texts: Same as in Course 1.

3. Mine Economics.

Among the subjects studied are: Factors governing the value of a mine; relation of labor, selling price of products, and profit; amortization of capital; ore sorting and its relation to profit; comparative efficiency of mining methods, plants, etc.; balancing the cost of mining equipments against the saving effected to see whether or not the installation is advisable.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Texts: Hoover, *Principles of Mining.*
Lecture Notes.

4. Ore Dressing.

This course includes a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil and acid flotation.

Prerequisites: Course 1 of Department I; Courses 1 and 2 of Department II; Course 10 of Department IV must precede or accompany.
Time: Class-room, three hours a week, first semester; two hours a week, second semester.
Text: Richards, *Ore Dressing and Concentration.*

5. Air Compression and Pumping.

Part 1: Discussion of pumping, pump problems, and pump details. Types of pumps: Force pumps, crank and fly wheel, direct acting, duplex, compound, and triple expansion pumps.

Part 2: A study of the action of air during compression and expansion, its flow through pipes, and also of the various types of air compressing and actuating machinery.

Prerequisites: Course 11 of Department IV and Course 2 of this department.
Time: Class-room, three hours a week, second semester.
Texts: Barr, *Pumping Machinery.*
Peele, *Compressed Air Plant.*

6. Design of Mine Plant.

The student is assigned problems relating to a given mine. He makes the requisite surveys, plans the top-works, selects the requisite machinery for a specified duty, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or of the Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings.

Time: Laboratory, three hours a week, first semester; six hours a week, second semester.

7. Mine Administration and Accounts.

Particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of sup-

plies, mine accounts, statement of cost, and monthly reports are discussed.

Time: Class-room, two hours a week, second semester.

8. Examinations of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside construction, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant.

Time: Class-room, one hour a week, second semester.
Field, three hours a week, second semester.

VII. DEPARTMENT OF METALLURGICAL ENGINEERING.

PROFESSOR GRAHAM.

The aim of the Metallurgical Department is to give its graduates a thorough working knowledge of assaying, chemistry, millwork and smelting processes; and to equip them with the knowledge necessary to the successful management of metallurgical plants, or to take charge of metallurgical operations.

This special training is given by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead: The crucible-assay of oxidized ores for gold and silver in the muffle in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assayers are considered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Courses 1, 2 and 3 of Department III.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Texts: Lodge, *Notes on Assaying.*

2. Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

Particular stress is laid upon the study of the more recent metallurgical practices and improvements of older processes. The course is supplemented by visits to neighboring plants.

Prerequisites: Course 1 of Department II; Course 1 of Department III; and Course 1 of Department V must precede or accompany.

Time: Class-room, three hours a week, first semester.

Text: L. S. Austin, *Metallurgy of the Common Metals.*

3. Furnaces.

This course is given by way of an extension of the topic "furnaces" as treated in General Metallurgy. It is concerned with the theories of high temperature generation, heat conservation, measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three hours a week, second semester.

Text: Damour, *Industrial Furnaces.*

4. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffett types of ore hearth; smelting lead ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; rever-

beratory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.

Time: Class-room, two hours a week, first semester.

Text: Peters, *Principles of Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel processes; cynaiding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Texts: Rose, *Gold.*
Collins, *Metallurgy of Silver.*

7. Metallurgy of Iron.

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron; gray cast-iron and spieged-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Text: Howe, *Metallurgy of Steel.*

8. Metallurgical Laboratory.

Laboratory work and investigation will be conducted along some of the following lines: Amalgamation of ores of gold and silver, chlorination of gold and silver ores, cyanidation of gold and silver ores, leaching methods for copper ores, electrolytic refining for copper and lead, slags.

Prerequisites: Courses 4, 5, 6, and 7 of this department must precede or accompany this course.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

9. Metallurgical Plant and Design.

The student devotes his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary

so that no two students have the same work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans for part of the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bills of materials made out for the portions of the work assigned, and the cost of the several parts carefully estimated according to the trade conditions and labor factors existing at the time. The entire work and all computations are carried out according to the best engineering practice and with the same care that actual construction operations require.

Prerequisites: Courses 9 and 10 of Department IV; Course 6 of Department V; and Course 2 of this Department.

Time: Class-room, one hour a week, first semester.
Laboratory, three hours a week, first semester, and six hours a week, second semester.

VIII. DEPARTMENT OF LANGUAGES.

PROFESSOR DRAKE.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge, for in Socorro and vicinity Spanish is as generally spoken as English.

1. Spanish. (Optional.)

The work is based on Worman's First and Second Spanish Readers. A part of the class exercise each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language with the idea of learning the grammar from the language rather than the language from the grammar.

Time: Two hours a week, one year.
Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish. (Optional.)

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar* being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.
Time: Two hours a week, one year.

ACADEMIC DEPARTMENT.

PROFESSOR SMITH.

The requirements for admission to the Academy are the same as those for standard secondary schools. A two-year course is offered, the work therein corresponding to that of the ninth and tenth grades of the standard high school.

Especial stress is placed on work in English writing. It is being recognized that a most necessary port of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

FIRST YEAR—FIRST SEMESTER.

Elementary Algebra.

To the subject of simultaneous linear equations, including the four fundamental operations; factoring, including the determination of the highest common factor and the lowest common multiple; linear equations; and problems depending on linear equations.

Time: Five hours a week.

Text: Wells, *Algebra for Secondary Schools.*

English I.

The Merchant of Venice, Bunker Hill Oration, and Snowbound are read and discussed in class. Some memorizing of significant passages is required. In the composition work, an attempt is made to interest the student at once in narrative writing, fluency and correctness of expression being sought primarily. Later in the year the work verges into exposition. During this semester each student is required to read and pass an examination in two of the following supplementary books: Ivanhoe, Tales from Shakespeare,

Autobiography of Franklin, Tom Brown's School Days, Robinson Crusoe, The First Jungle Book, and Pilgrim's Progress. Reading Course examinations are held about the middle of November and the first of January.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physiography.

Wherever possible, in this course, facts obtained by actual observation are made to verify and supplement the text used. There are daily assigned observations of clouds, winds and temperature, and a study of erosion by wind and water and of geologic formation is made in excursions to near-by arroyos and canyons. In connection with the study of stream-flow, attention is called to the great importance of forest preservation to the people of the West.

Time: Five forty-five minute periods a week.

Text: Fairbanks, *Practical Physiography.*

FIRST YEAR—SECOND SEMESTER.

Elementary Algebra.

Radicals, including the extraction of square root; exponents, including the fractional and negative; quadratic equations; problems depending on quadratic equations; the binomial theorem for positive and negative exponents.

Time: Five hours a week.

Text: Wells, *Algebra for Secondary Schools.*

English I.

A continuation of the first semester's work in this subject. Shakespeare's Temptest, Eliot's Silas Marner, and Bryant's Sella and Thanatopsis are read and discussed in class. As in the first semester, each student is required to read and pass examination in two of the supplementary books offered in this course. These examinations will be given in March and May.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physiography.

The work during the second semester is a continuation of that of the first. A book of notes is kept by each pupil, during the year, based on the text, and on practical observation and research.

Time: Five forty-five minute periods a week.
Text: Fairbanks, *Practical Physiography.*

SECOND YEAR—FIRST SEMESTER.

Plane Geometry.

The usual theorms and constructions of good text-books, including the general propositions of plane rectilinear figures; the circle and measurement of angles; similar polygons; areas; regular polygons; and the solution of numerous original exercises.
Time: Five hours a week.
Text: Slaught and Lennes, *Plane Geometry.*

English II.

Julius Caesar, Richard III, and the Letters of Washington are studied in class. The same plan is pursued in the writing work as in English I. This semester each student is required to read and pass examination in two of the following supplementary books: Tale of Two Cities, David Copperfield, Hoosier Schoolmaster, Last of the Mohicans, Vicar of Wakefield, and assigned portions from The Sketch Book. These examinations will be given as in English I.
Time: Five forty-five minute periods a week.
Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physics.

This course runs throughout the entire year, the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. The splendid equipment of physical apparatus renders it possible to supplement the text by daily experiments and demonstrations. During this semester the subjects of mechanics and heat are treated.
Time: Five hours a week.
Text: Carhart and Chute, *High School Physics.*

History.

For the benefit of those who have not had the opportunity to study Ancient History a brief review of that subject is made. Grecian and Roman History are given their proper emphasis. Special attention is paid to the History of Western Europe since

the barbarian invasion, with emphasis on the bearing of old-world events upon the history of the Americans. In the study of such things as the mediaeval town, life in the feudal castle and the Renaissance, an attempt is made to cause the student to realize these things as aspects of the daily existence of common men and women, which he would have lived likewise under like conditions, rather than to obtain a fixed mental chronology of dates and occurrences. Frequent written reviews are given throughout the course. Essays on certain assigned historical subjects are required.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

SECOND YEAR—SECOND SEMESTER.

Solid Geometry.

The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders, and cones; the sphere; and the spherical triangle.

Time: Five hours a week.

Text: Slaught and Lennes, *Solid Geometry.*

English II.

During the second semester the student's time and attention are devoted to a study of the history and development of English Literature. Extracts from the classics are read and discussed in class; note books are kept based upon the text studied.

Time: Five forty-five minute periods a week.

Text: Long, *English Literature.*

Physics.

This is a continuation of the first semester's work. Electricity, sound, and light are treated in much the same manner as the subjects of the first half of the year.

Time: Five hours a week.

Text: Carhart and Chute, *High School Physics.*

History.

This is a continuation of the first semester's work.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

PHYSICAL TRAINING.

Physical training has become a distinct feature of the student's activity at nearly all institutions of higher education. Rationally indulged in it is an exceedingly valuable feature, as is attested by both reason and experience. It is superfluous to argue that a sound mind and an unsound body constitute a very unfortunate combination. The ideal young man of the day, the young man who gives promise of greatest usefulness, is sound in both mind and body. The health of the body and the consequent health of the mind can not be promoted without proper attention to the laws of physical exercise. Physical training thus becomes, as it should become in an educational institution, a valuable means for the accomplishment of the very end and aim of the institution itself.

At the School of Mines athletics has been receiving increased attention in the last few years. The foot-ball and baseball teams have made a good record for themselves and they are confidently anticipating better records for 1912. It is to be hoped that an intercollegiate athletic association will soon be organized among the students of the respective collegiate institutions of New Mexico; in fact, the subject of the organization of such an association has already been considerably discussed. When the organization is perfected, the School of Mines may be expected to give a good account of itself in an athletic way.

Care is taken, however, and will continue to be taken to make athletics merely a means of keeping the young men at the School of Mines in the best possible physical condition to do the work for which they came to the institution. While it accomplishes this purpose it naturally fosters and develops a strong college spirit, and this, too, is a species of enthusiasm that is by no means to be despised in the work of educating young men for the activities of their later years.

Each student who enrolls at the School of Mines is charged a fee of $5.00 for the support of the athletic association.

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus contains 20 acres of nearly level ground on the outskirts of the city of Socorro. Groves of trees have been planted and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet deep, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite in broken ashler and is trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated, heated with a good hot-water system, piped for water and gas, and wired for electricity for illumination and for experimental purposes.

As now arranged the main floor of this building contains the president's office, the mineralogical museum, the qualitative chemical laboratory and instructor's office, the assay laboratory and balance rooms, and a lecture room. The basement contains two lecture rooms, the physical laboratory, and instructor's private mineralogical laboratory, the quantitative chemical laboratory, the electro-chemical laboratory, an instructor's private chemical laboratory, the chemical supply rooms, a photographic dark room, the boiler room, the engine room, the hot water heating plant, and the lavatories. A lecture room, now occupied by the department of mathematics, is located on the second floor. The main library occupies the third floor.

Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion the building is to be X-shaped, the central pavilion two stories and the four wings one story. With its spacious rooms it will be peculiarly adapted to engineering instruction.

When the building is completed the entire north wing will be devoted to draughting purposes, the light coming from above. At

present the main draughting-room is in the south wing which also is a lecture room. Off this are the instructor's office and a blue-print room. A photographic room is fitted up in the main building.

Dormitory.

The School of Mines suffered long for lack of dormitory accommodations. In fact, it is known that many students who would otherwise have come to the School of Mines in years past went to other institutions because of the lack of the lower cost of living which a dormitory here would have afforded. However, the $15,000 generously appropriated by the territorial legislature was expended with the result that the School of Mines is equipped with what is probably the best dormitory in New Mexico. The building is heated with hot water and lighted with electricity. There are a dining room and kitchen in connection, also a bath room on each of the two floors and a shower bath in the basement. The assembly room, on the first floor, which is now equipped for the accommodation of the academic department, promises to meet all the requirements of that department for some time to come. The building is designed to afford accommodations for about thirty students and from time to time has been occupied to practically its full capacity. The dormitory contributes greatly to the convenience and comfort of the students in attendance at the School of Mines and is sure to be an important agency in increasing that attendance.

It has already been demonstrated that students can be accommodated with board and lodging at the dormitory at the rate of $20 a month, they being required to furnish only their own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself, and no student will be accommodated in this way to the exclusion of another student from dormitory privileges. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture. After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application.

EQUIPMENT.

Chemical Laboratories.

The chemical laboratories have recently been greatly enlarged and improved. As now arranged they occupy the entire south wing of the main building, while the store room, private laboratory, and chemical lecture room are located in the central section of the same building. Elements of chemistry and qualitative analysis are taught in the large laboratory on the main floor. The room, which is exceptionally well lighted and ventilated, is equipped with large hoods, a balance room, and twenty-four desks, each of which is supplied with gas, water, and electric light.

The basement laboratory has recently been remodeled and fitted with large windows, glass partitions, and modern desks. The east half of it used for quantitative analysis and wet assaying. There are large hoods in each end which are supplied with hot plates and drying ovens, while each desk is equipped with an Alberine stone sink, water, gas, and electric light.

In the west half of the basement there are the instructor's laboratory, electro-chemical laboratory, and balance room. The latter is fully equipped with the best analytical balances supported upon a solid concrete table which is entirely free from vibration. The electro-chemical laboratory is supplied with current from a modern storage battery plant, consisting of a motor-generator, storage cells, and a switch-board so arranged that each student may obtain any current he desires for analytical or other electro chemical experiments. There is also a supply of alternating current from the city circuit which is used for light and small electric furnaces.

The laboratory is very completely equipped not only with all apparatus, chemicals, and supplies needed for the various courses, but the stock includes a large amount of pure chemicals and special apparatus, including standardized burettes, flasks, and weights which are used for the most accurate rock analysis and research work.

All apparatus is loaned to the students. Chemicals and supplies are furnished at cost.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and

include muffle gasoline blow-pipe furnaces of different types and large muffle coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes, and other assaying materials and supplies.

A weighing-room containing a number of Becker's balances is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher and a Bolthoff sample-grinder and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers, and other necessary apparatus.

Physical Laboratory.

The physical laboratory occupies the north end of the north basement of the main building and contains the usual apparatus for illustrating the facts and laws of physics. In addition there has just been added at a considerable expense all the apparatus necessary to perform the quantitative experiments outlined in Course 2 of Department II.

Petrographical Laboratory.

For the microscopic study of rocks both in elementary and advanced or graduate work the School is well supplied with microscopes and other necessary apparatus. There has recently been added to the equipment a new style large microscope manufactured especially for this institution by Reichert of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model sub-stage with rack and pinion, an Abbe sub-stage condenser with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objective and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparatus, stage micrometer, drawing apparatus, quartz-wedge, quarter-undulating micaplate, and other necessary pieces.

A rock-slicing machine with power attachments enables the student to prepare thin sections of the rocks which is he studying.

Among the series of thin-slices of rocks a collection of types of the massive crystallines of Europe prepared by Krantz of Bonn and completely illustrating Zirkel, sets of Maryland massives, and other American rocks and minerals. The Sturtz collection of European rocks illustrating Rosenbush and large miscellaneous collections are expected to be soon available for study.

ENGINEERING INSTRUMENTS.

The Civil Engineering Department has all the instruments necessary for land, railroad, irrigation, mine, and topographic surveys. These include chains, tapes, range-poles, level rods, wye and dumpy levels, complete transits, and plane tables. In purchasing instruments for this department only the best grade has been considered and the student has the opportunity to become familiar with the product of such well known manufacturers as Gurley & Sons, Eugene Dietzgen, Buff & Buff, etc.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the engineering building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame on steel track, developing-vat, and drying rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. An Ingersol-Rand drill and other pieces of machinery are used as models.

Mineralogical Museum.

The Schools owns a very fine collection of minerals of all kinds. These properly labeled and arranged in glass cases are housed in the north wing of the main building.

The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school it attracted wide attention.

The display was planned to center around a large colored relief-model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model were shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases, were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals which for variety, deli-

cacy of coloration, and beauty have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the museum of the School of Mines.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats, and atlases, and volumes on history, travel, and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.
Mining and Scientific Press.
Engineering Record.
Power.
Engineering News.
Mining Science.
Mines and Minerals.
Engineering Magazine.
Journal of the American Chemical Society.
Journal of Industrial and Engineering Chemistry.
Chemical Abstracts.
Review of Reviews.
Economic Geology.
School of Mines Quarterly.
New Mexico Journal of Education.
All the U. S. G. S. Publications.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully

chosen treatises, text-books, monographs, special contributions and author's separates, pertaining to the respective divisions.

Powell Library.—The School has come into possession of the private library of the late Major John W. Powell of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology, and philosophy, many of which are rare and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great southwest. It was in these fields that Major Powell did most of his work which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who has been so long identified with this western country, should find a permanent home in New Mexico.

THE TORRANCE MINE.

The Torrance gold and silver mine at the base of Socorro mountain, only about two miles from the School campus, affords excellent opportunities for the practice of mine-surveying and for a study of some features of practical mining. The opening is a double-compartment incline shaft, timbered, with various levels, cross-cuts, winzes, shafts, and stopes. The ore-bodies with associated geological structures and many other features will interest the student of mining engineering.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is twenty-five dollars a semester except to citizens of New Mexico, the tuition fee for the latter being ten dollars a semester. This is payable at registration and its payment after matriculation admits the student to all class-room instruction. Students who hold scholarships pay no fee for tuition.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water, and materials for which the student does not pay directly and to

compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Quantitative Analysis, Water and Fuel Analysis, Inorganic Preparations, Organic Chemistry, Electro-Analysis, Photography, Physics, each $5.00; Qualitative Analysis, Ore Analysis, each $7.50; Fire Assaying, $10.00; Mineralogy (Blowpipe Analysis) $3.00; Metallurgical Laboratory, $3.00; Mine examination, $1.00.

A deposit of $2.00 is required from each student who registers for any of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due from the breakage of apparatus.

Graduation Fee.

The graduation fee, payable after delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer	$10.00
Bachelor of Science	5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month; board at the hotels and best boarding-houses for $7.00 a week. The cost of living at the dormitory is $20 a month.

Books and Other Supplies.

Books and other supplies for students are furnished through the office at publishers' prices with the freight or express charges added. A considerable saving is thus made in behalf of the student.

Summary of Annual Expenses.

A close approximation of a student's necessary annual expenses is tabulated below. By the practice of extreme economy a student may, of course, cut his expenses somewhat below the figures here given.

Board and room at the dormitory	$180.00
Books and other supplies	60.00
Laboratory and other fees	25.00
Total	$265.00

SCHOLARSHIPS AND PRIZES.

Scholarships.

Through the generosity of the members of the Board of Trustees, of the Thirty-seventh General Assembly of New Mexico, and of the Allis-Chalmers Company, the New Mexico School of Mines has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

School of Mines State-Scholarships.—To one student from each state of the Union is open a scholarship yielding free tuition. Each scholarship may be held for one year and is assigned to that applicant who shows the greatest proficiency in subjects already pursued by him. Application must be made in writing to the President and in the case of those who have not been students in the School must be accompanied by a certified statement of subjects pursued and the grades received therein unless the applicant prefers to pass an examination in the subjects for which he seeks credit.

School of Mines County-Scholarships.—Scholarships are open to two students from each county in New Mexico. These scholarships yield free tuition and are subject to the same conditions as the State-Scholarships.

New Mexico Scholarships.—The Thirty-seventh General Assembly of New Mexico gave to each representative, to each councilman, and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the territory and provided an appropriation of $200.00 for each appointee.

Allis-Chalmers Scholarship.—To one member of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee, and Scranton, an opportunity for four months' study and employment in any of its plants and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an

exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Prizes.

The Brown Medal.—Hon. C. T. Brown of Socorro offers annually a gold medal to the student who, while doing a full year's work, has shown the greatest proficiency in the courses in Wet Assaying and Fire Assaying. The medal is awarded each year at commencement. Only those students are eligible as contestants for the medal who at commencement are found to have completed the courses named and, of course, the prerequisites to these courses.

In case of a tie in the grade of proficiency between two or more contestants, special specimens of ore are submitted to them for assaying, until the tie is broken.

SUMMER WORK.

The proximity of the School to mineral properties, mines, and smelters makes it easy for the student to secure employment during the summer (and during the Christmas vacation, if desired) and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining, have been attractive fields of work for the students during the vacations.

DEGREES.

The degrees of Bachelor of Science, Mining Engineer and Civil Engineer are conferred by the Board of Trustees upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of the institution, have completed the prescribed collegiate courses of any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence

of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed courses of the four-year curriculum in Mining Engineering, Metallurgical Engineering, or Mining Geology, has presented an orignal and satisfactory dissertation in the line of his work, and has done two years of professional work of which one has been in a position of responsibility. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum, and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the Mining Engineer, except that the candidate substitutes, in some of his later work, courses which relate more directly to the profession he expects subsequently to follow.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but in each case the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidence of independent investigation to warrant its publication in whole or in part.

COMMERCIAL ANALYSES.

The wide demand which exists in the great mining district of the southwest for disinterested and scientific tests and practical investigations has led to the establishment by the New Mexico School of Mines of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible and accurate results assured by reason of the exceptional facilities of the laboratories of the School and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines."

A special circular is issued, giving the schedule of charges, other necessary information, and methods of preparing and shipping samples. Copies are mailed on application. By special resolution it is required that all charges shall be paid in advance.

Commercial Assaying.—The assaying for gold, silver, copper, lead, zinc, and the common metals is carried on in all its various phases. All work is run in duplicate and, in case of any non-concordant results, such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese, and the rarer metals such as uranium, vanadium, nickel, and cobalt are made according to the best methods.

Water Analysis.—The chemical analysis of waters for city-water supplies, boilers, and domestic use, and of mineral and mine-waters has of late assumed great importance. The chemical laboratory of the School is fully equipped for this work and in the case of bad waters remedies and methods to be used to improve the waters for specific purposes are suggested. A large number of analyses

of waters from the southwest have already been made and very interesting results obtained.

Fuel Analysis.—Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coal regions. Complete analyses and heat tests have been made of some of the principle deposits. With the work already done the results of new analyses are made of special value on account of the comparative figures that can be supplied.

DIRECTORY OF GRADUATES AND FORMER STUDENTS.

ARTHUR H. ABERNATHY. Mapimi, Mexico.

Student, 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, 1901; Assistant sampleman, Minera de Penoles Co., Mapimi, Durango, Mexico, 1909-10; Sampling foreman, Minera de Penoles Co., Mapimi, Durango, Mexico, 1910—.

GEORGE C. BAER, Mogollon, New Mexico.

(B. S., New Mexico School of Mines, 1910.)

Assayer, Tri-Bullion Company, Kelly, New Mexico, 1910; Millman, Socorro Mines Company, Mogollon New Mexico, 1911; Mill foreman, Socorro Mines Company, Mogollon, New Mexico, 1912—.

C. E. BARCLAY. Maria, Texas.

(A. B. University of Virginia.)

Student, 1896-97. From Bowling Green, Kentucky.

JAMES HENRY BATCHELDER, Jr. Socorro, New Mexico.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)

Mining Chloride, New Mexico, 1911.

THOMAS HORTON BENTLEY, Vancouver, British Columbia.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)

Surveyor with Milbon and Raffles, Nacozari, Sonora, Mexico, 1910; General engineering work, Hermosillo, Sonora, Mexico, 1911; Mining engineer, Portland, Oregon, 1911; Assistant Superintendent, Norton Griffiths, Steel Construction Company of London, England, with headquarters at Vancouver, British Columbia, Canada.

JAMES F. BERRY. Angangueo, Michoacan, Mexico.

Student, 1904-05. From Socorro, N. M. Assayer with American Smelting and Refining Company, at Aguas Calientes, 1905; Assayer City of Mexico, 1906-07; Chemist, Cia Metalurgica y Refinadora del Pacifico, Fundicion, Sonora, Mexico, 1907-8; Assistant Mine Superintendent, American Smelting and Refining Company, Angangueo, Michiocan, Mexico, 1909—

LOUIS AUGUST BERTRAND, Upland, Nebraska.

Student, 1895-6. From Conway, Iowa. Student Ecole Professionella de l'East, Nancy, Lorraine, 1890-95; Instructor in Mathematics and French, New Mexico School of Mines, 1895-96; Chemist El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Company, Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Superintendent, Compania Mineros de Penoles, Mapimi, Durango, Mexico, 1901.

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†Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

HARRY LAWRENCE BROWN. Los Angeles, California.

Student 1903-1905. From Chicago, Illinois. Positions: Assayer, Ernestine Mining Company, Mogollon, New Mexico; Engineer Cia Concheno Beneficiador, Mexico; Mill superintendent, Milwaukee Gold Extraction Company, Phillipsburg, Montana; Engineer, Transvaal Copper Company, Sonora, Mexico; Manager, Morning Star Mining Company, Ophir, Colorado; Manager, San Carlos Mining Company, Sonora, Mexico; Manager of six properties and consulting engineer, Cobalt, Ontario; Superintendent, Haile Gold Mine, Kershaw, South Carolina; Exploration work in Venezuela, South America; Mill superintendent, National Mining Company, National, Nevada; At present mining engineer, Los Angeles, California.

CHANUCEY E. BUTLER.* Dedrich, California.

Student, 1893-6. From Kelly, New Mexico. Assayer Cibolo Creek Mill and Mining Company, San Francisco, California, 1896; Assayer and Furnace Superintendent, La Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897-98; Chemist and Assayer, United Verde Copper Company, Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Company, and Jenny Lind and Maple Mining Company, Dedrich, California, 1903.

R. HARLAND CASE. Colorado Springs, Colorado.

Student, 1902-5. From Cerrillos, N. M. Chemist, Compania Metalurgica de Torreon,Torreon, Mexico, 1905-6; Assistant Superintendent Bonanza Mine, Zacatecas, Mexico, 1906; Assistant-Manager, Stephenson-Bennett Mining and Milling Company, Organ, New Mexico, 1906-7; Consulting Engineer, Western Mining, Milling and Leasing Company, Colorado Springs, Colorado, 1907-8.

EDWARD C. CHAMNEY. Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-1; Assayer, Oro Mining Company, Minnehaha, Arizona, 1901.

VIVIAN V. CLARK, Seattle, Washington.

Student, 1896-8. From Kelly, New Mexico. Assayer, Bland Mining Company, Bland, New Mexico, 1898-9; Superintendent, Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine Operator, Albuquerque, New Mexico, 1902; Manager, Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903-1908; Consulting Engineer, Consolidated Exploration Mines Company, New York, and allied syndicates, 1909-10; President, Northern Engineering Company, Seattle, Washington, 1910—.

DAVID JOSHUE CLOYD. Saltillo, Nuevo Leon, Mexico.

Student, 1899-1900. From Decatur, Illinois. Chemist and Assayer, Wardman's Assay Office, Aguas Calientes, Mexico, 1900-1906; Assist-

*Deceased.

ant Superintendent, Cia Minera del Tiro General, Charcas, S. L. P. and Assistant Superintendent, Cia del Ferrocarril Central de Potosi, Charcas, S. L. P., 1906-8; Assayer and Chemist Dailey, Wisner & Company, Torreon, Coah., Mexico, 1908; at present, chief assayer and chemist Mazapie Copper Company, Saltillo Plant, Saltillo, Nuevo Leon, Mexico.

SAMUEL COCKERILL. Milwaukee, Wisconsin.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-6. From North Fork, Virginia. Post-Graduate Engineering Course, Allis-Chalmers Company, 1906-8; Milwaukee Coke and Gas Company, 1908—.

LEON DOMINIAN. New York, N. Y.

(B. A., Roberts College, Constantinople, 1898; C. I. M. Mining School, University of Liege, 1900.)

Graduate Student, 1903-4. From Constantinople, Turkey. Assistant, U S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-4; Engineer to Victor Fuel and Iron Company, Denver, Colorado, 1904-6; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-7; Consulting Engineer, Mexico City, Mexico, 1908-9; Consulting Engineer, New York, N. Y., 1910.

ROBERT CASIANO EATON* Leon, Guanajuato, Mexico.

Student, 1893-4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1894-8; Superintendent, Mueriedas Smelting Works, Xichu, Guanajuato, Mexico, 1898; Superintendent, Pozo del Carmen Railroad, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager Nuevo Cinco Senores Mining and Milling Company, Comanja, Jalisco, Mexico, 1902-4; Independent Assayer and Ore Buyer in Leon, Gto., Mexico, since 1904.

ALEXANDER WALTER EDELEN. Angangueo, Michiocan, Mexico.

Student, 1905-6. From Baltimore, Maryland. Assistant Superintendent, Elkton Consolidated Mining and Milling Company, Elkton, Colorado, 1906; Superintendent Minas Bonanzas y Anexas, Zacatecas, Mexico, 1907-1909; Mine Superintendent, American Smelting and Refining Company, Angangueo, Michiocan, Mexico, 1909—.

THADDEUS BELL EVERHEART. Chloride, New Mexico.

Student, 1905-7. From Bels, Texas. Assayer and Surveyor, Pereguina Mining and Milling Company, Guanajuato, Mexico, 1907-8; Mill Superintendent, Las Animas Mining and Milling Company, Pueblo Nuevo, Durango, Mexico, 1909-10; Mining, Chloride, New Mexico, 1911.

HARRY THORWALD-GOODJOHN. Torreon, Coahuila, Mexico.

Student, 1902-3. From Pittsburg, Texas. Assayer, Cia. Metalurgica del Torreon, State of Coahuila, Mexico, 1903-1906; Chief Chemist, Ma-

*Deceased.

pimi Smelter, 1906; Chemist and Metallurgist, Cia. Minera, Fundidora y Afinadora, Monterey, Mexico, 1907-8; Chief Chemist, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1909—.

SAMUEL JAMES GORMLEY. West Jordan, Utah.

Student, 1895-6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895-6; Assistant Assayer, Anaconda Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist to same company, 1900-2; Superintendent of Sampling Works, Washoe Smelting Company, Anaconda, Montana, 1902-6; Smelter Superintendent, Bingham Copper and Gold Mining Company, West Jordan, Utah, 1906.

RUE N. HINES.* El Paso, Texas.

(B. S., New Mexico School of Mines, 1907.)

Student, 1904-7. From Socorro, New Mexico. Superintendent, West Coast Mining and Smelting Company, Mocorito, Sinaloa, Mexico, 1907-1909; Locating and developing prospects in Arizpe District, Sonora, Mexico, 1910; Secretary, First Mortgage and Security Company, El Paso, Texas, 1911.

EDMUND NORRIS HOBART. Concepcion del Oro, Zacatecas, Mexico.

(B. S., New Mexico School of Mines, 1910.)

Student, 1906-8, 1909-10. From Clifton, Arizona. Chemist, Socorro Mines Company, Mogollon, New Mexico, 1909; Chief Sampleman, Shannon Copper Company, Clifton, Arizona, 1910-11. Assistant surveyor, American Smelting and Refining Company, Angangueo, Michiocan, Mexico, 1911; Resident Engineer, Capristante Mines Group, Mazapil Copper Company, Limited, Concepcion del Oro, Zacatecas, Mexico, 1912—

ANTON HOGWALL. Nogal, New Mexico.

Student, 1898-9. From White Oaks, New Mexico. Assayer, Buckeye Mining Company, Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Company, and Helen Rae Mining Company, White Oaks, New Mexico, 1901; Assayer, American Gold Mining Company, Nogal, New Mexico, 1902.

CARL JOHN HOMME. Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate Student, 1899-1900. From Wittenburg, Wisconsin. Assayer and Chemist to Candelaria Mining Company, El Paso, Texas, 1900-01; Assistant Superintendent Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902.

WILLIAMS ELIAS HOMME. Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate Student, 1902-03. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

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*Deceased.

HAYNES A. HOWELL. Mexico City, Mexico.

Student, 1900-1905. From Socorro, New Mexico. Civil Engineer on railway from Acapulco, Mexico, 1906-07; Civil Engineer, Mexican Central R. R., 1907—.

HARRY J. HUBBARD. Rosario, Sinaloa, Mexico.

(B. S., New Mexico School of Mines, 1906.)

Student, 1905-6. From Bisbee, Arizona. Mine-foreman, Navidad Mine of Greene Gold-Silver Company, Concheno, Chihuahua, Mexico, 1906; Chemist, Navidad Mine of Greene Gold-Silver Company, 1906; Assistant Mill Superintendent, Sahuauycan Mining Company, Sahuauycan, Chihuahua, Mexico, 1906; Machine Drill Foreman, Sirena Mine Guanajuato, Mexico, 1907; Shift-boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan and Associates, in southern states of Mexico, 1907; Tramway Superintendent, Minas Bonanzas y Anexas, Bonanza, Zac., Mexico, 1908; Foreman, Butters Divisavero Mines, Jocoro, San Salvador, Central America, 1909-10; Superintendent, Las Animas Mining Company, Hermosillo, Sonora, Mexico, 1910; Foreman, Minas del Tajo, Rosario, Sinaloa, Mexico, 1911—.

JOHN AUGUST HUNTER, Tucson, Arizona.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-4; Chemist and Metallurgist, American Smelting and Refining Comuany, Aguas Calientes, Mexico, 1904-8; Metallurgist, Congress Mining Company, Congress, Arizona, 1909-10; Assayer, Los Angeles, California, 1910-11; Engineer, Pioneer Mining Company, Tucson, Arizona, 1911—.

CHARLES THAYER LINCOLN. New York, N. Y.

(S. B., Massachusetts Institute of Technology, 1901.)

Graduate Student, 1902-3. From Boston, Massachusetts. Chemist to American Bell Telephone Company, Boston, Massachusetts, 1901-2; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-3; Acting Professor, same, 1903-4; Instructor in Chemistry, Iowa State University, Iowa City, 1904-5; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-7; Chemist, Arbuckle's Brothers Sugar Refinery, Brooklyn, New York, 1907-9; Chemist, United States Custom Service, New York, N. Y., 1910—.

FRANCIS CHURCH LINCOLN. New York, N. Y.

(S. B., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1902.)

Assayer to San Bernardo Mining and Millling Company, 1900; Chemist to Butterfly Terrible Gold Mining Company, 1900-1; Professor of Metallurgy, New Mexico School of Mines, 1902-4; Assistant Superintendent, Ruby Gold and Copper Company, Ortiz, State of Sonora, Mexico, 1904; General Manager, Arizona Gold and Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907-10; Mining Engineer, New York, N. Y., 1911—.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer with Illinois Steel Company, 1900.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University; M. D., Bellevue Hospital.)

Graduate Student, 1900-1. From New York City, 136 Fifth Avenue, New York City, 1901.

DANIEL M. MILLER. Lake Valley, New Mexico.

(B. S., New Mexico School of Mines, 1909.)

Student, 1906-9. From Lake Valley, New Mexico.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899-1900. From Santa Ana, California. County Surveyor, Orange County, California, 1900-1; Assistant Engineer, Temescal Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Company, 1901-2; Assistant Engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

EARLE GIBBON MORGAN, Mogollon, New Mexico.

(E. M., New Mexico School of Mines, 1911.)

Student, 1907-8, 1910-11. From Lansdowne, Pennsylvania. Mining Engineer, Socorro Mines Company, Mogollon, New Mexico, 1911—.

ERLE D. MORTON. Superior, Montana.

(E. M. in Geology, New Mexico School of Mines, 1909.)

Student, 1903-5, 1908-9. From Los Angeles, California. Assistant Superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-6; Washington University, 1906-7; Mine Examiner, Los Angeles, California, 1907-8; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908; Mine Superintendent, Arizona and Nevada Copper Company, Luning, Nevada, 1909-10; Mining Engineer, Los Angeles, California, 1910; Chief Engineer, Lone Mountain Tunnel Company, Superior, Montana, 1911—.

WILLIAM FREDERICK MURRAY, Nlilagua, Colorado.

Student, 1904-6. From Raton, New Mexico. In Chief Engineer's Office of the Victor Coal Company, Denver, 1906-7; Assistant Engineer, Victor Fuel Company, 1907-8; Assistant to Chief and Traveling Engineer, Victor Fuel Company, and Colorado and South Eastern Railway Company, 1908; Assistant Superintendent, Hastings Mine, Victor Fuel Company, Hastings, Colorado, 1909-10; Superintendent, Cass Mine, Victor American Fuel Company, Nlilagua, Colorado, 1910—.

PATRICK J. O'CARROL.*

(B. A., University of Dublin, Ireland.)

Graduate Student, 1898-9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896. Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

*Deceased.

JUAN PALISSO. Mexico.

Student, 1903-4. From Barcelona, Spain. Mining Engineer, Mexico.

ORESTE PERAGALLO. El Paso, Texas.

(E. M., New Mexico School of Mines, 1908.)

Student, 1907-8. From Ciudad Juarez, Chihuahua, Mexico. Mining Engineer, El Paso, Texas, 1908-10; Graduate Student, New Mexico School of Mines, 1910-11; Mining Engineer, El Paso, Texas, 1911—.

FOUNT RAY. Italy, Texas.

Student, 1901-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Company, Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902.

ALBERT BRONSON RICHMOND. Tucson, Arizona.

Student, 1900-1. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gabilan, Sonora, Mexico, 1901-2; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and Metallurgist, Patagonia, Arizona; General Manager, Mansfield Mining and Smelting Company, Patagonia, Arizona, 1908; Consulting Engineer, Tucson, Arizona, 1909; Field Engineer, Mines Company of America, with headquarters at Tucson, Arizona, 1910—.

DELL FRANK RIDDELL. Parral, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; M. E., New Mexico School of Mines, 1905.)

Graduate Student, 1903-5. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4; Acting Professor of Assaying, same, 1904-5; Holder of Allis-Chalmers Scholarship, 1905-6; Engineer Universam Pump and Manufacturing Company, Kansas City, Missouri, 1906-7; Superintendent, Benito Juarez Mine, Parral, Chihuahua, Mexico, 1907-8; Consulting Engineer and Acting Superintendent, Germania Mining Co., Springdale, Washington, 1910; Chief Samp-

ORLANDO DOUGLAS ROBBINS. Indiana Harbor, Indiana.

(E. M., New Mexico School of Mines, 1909.)

Student, 1905-9. From Louisville, Kentucky. Chemist, Santa Rita Mining Company, Santa Rita, New Mexico, 1909-10; Mill Superintendent, Germania Mining Co., Springdale, Washington, 1910; Chief Sampler, Inspiration Copper Company, Globe, Arizona, 1910; Engineer, United States Steel Company, Indiana Harbor, Indiana, 1911—.

WILLIAM CARLOS STEVENSON,* Redlands, California.

Student, 1900-1. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1903-4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1902.

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*Deceased.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

(B. S., in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)

Student, 1895-6. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate Student, Johns Hopkins University, 1897-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1903-4. From Peoria, Illinois. Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Seattle, Washington.

(B. S., M. S., University of Illinois; LL. B., University of Michigan; A. M., Ph. D., Columbia University.)

Graduate Student, 1901-2. Mining Lawyer, Seattle, Washington.

OLIVER RUSSELL SMITH. Zillah, Washington.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1898; C. E., New Mexico School of Mines, 1903.)

Graduate Student, 1899-1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1; Instructor in Engineering and Drawing, New Mexico School of Mines, 1901-2; Assistant Professor in Engineering and Drawing, New Mexico School of Mines, 1902; Assistant Survey, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902; Deputy Mineral Surveyor, U. S. Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1902-7; Civil Engineer, Santa Fe R. R., San Bernadino, California, 1907-8; Engineer, United States Reclamation Service, Zillah, Washington, 1908-10.

OTTO JOSEPH TUSCHKA, Monterey, Mexico.

(E. M., in Metallurgy, New Mexico School of Mines, 1897.)

Student, 1893-7. Assayer and Chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-8; Graduate Student, New Mexico School of Mines, 1898-9; Assistant Sampling Mill Foreman and Chemist, Guggenheim Smelting and Refining Company, Monterey, and Aguas Calientes, Mexico, 1899-1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chief Chemist, Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

MILTON BENHAM WESTCOTT. Monterey, Mexico.

Student, 1904-5. From Chicago. Engineering Corps, Santa Fe Railroad, 1905; Assistant County Surveyor, El Paso County, 1906-7; Assistant Engineer, Monterey Railway, Light and Power Company, Monterey, Mexico, 1907; Assistant Engineer, Monterey Waterworks and Sewer Company, 1907-8; Resident Engineer, Monterey Water Works and Sewer Company, 1908.

PATRICK ANDREW WICKHAM. Maris, Chihuahua, Mexico.

Student, 1893-4. From Socorro, New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Company, and Albermarle Mining Company, Bland, New Mexico, 1898-9; Mechanical Engineer, Mt. Beauty Mining Company, Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Company, Cripple Creek, Colorado, 1900-1; Foreman, Guggenheim Exploration Company, Minas Tecolotes, Santa Barbara, Mexico, 1901-2; Foreman, Independence Consolidated Gold Mining Company, Cripple Creek, Colorado, 1902-4; Manager, Consuelo and Esperanza Gold Mining Companies, Dolores, Mexico, 1904-6; Assistant Superintendent, Kelvin-Calumet Copper Mining Company, Ray, Arizona, 1907-8; Superintendent, La Cienega Mining Company, Maris, Chihuahua, Mexico, 1909.—

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.

Student, 1893-4. From Council Bluffs, Iowa. Assistant Superintendent and Metallurgist, Granby Consolidated Mining, Smelting and Power Company, Limited, Grand Forks, B. C., 1898; at present Superintendent of the same.

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ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1912-1913

WITH ANNOUNCEMENTS FOR 1913-1914

MAIN BUILDING

ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1912-1913

WITH ANNOUNCEMENTS FOR 1913-1914

ALBUQUERQUE
ALBRIGHT & ANDERSON
1913

CALENDAR.
1913-1914.

First Semester:

September 8, Monday—Registration of students.

November 27 and 28, Thursday and Friday—Thanksgiving recess.

December 21—Christmas vacation begins.

January 5, Monday—Work resumed.

January 12-15, Monday-Thursday—Examinations.

Second Semester:

January 16, Friday—Registration of students.

May 11-14, Monday-Thursday—Examinations.

May 15, Friday—Commencement.

BOARD OF TRUSTEES.

OFFICERS OF THE BOARD.

FACULTY.

Emmet Addis Drake................*President of the Faculty*
A. B., Wisconsin University, 1882; A. M. 1887.

George Irving Kemmerer.............*Professor of Chemistry*
A. B., Wisconsin University, 1904; A. M., 1906; Ph. D., University of Pennsylvania, 1908.

Byron Kemp Coghlan..........*Professor of Civil Engineering*
B. S., University of Illinois, 1908.

Gustavus Edwin Anderson,.......................
.....................*Professor of Geology and Mineralogy*
S. B., University of Chicago, 1905; A. M., Columbia University, 1906.

John Fraser Graham....*Professor of Mining and Metallurgy*
B. S., Michigan College of Mines, 1905.

Thomas Calvin MacKay.............*Professor of Mathematics*
A. B., Dalhousie University, 1893; A. M., Harvard University, 1899; Ph. D., 1903.

Viggo E. Hanson........*Instructor in Mechanical Engineering*
B. S., State University of South Dakota, 1910.

Carl Clyde Smith.................*Principal of the Academy*
Ph. B., Ohio State University, 1890.

Anne W. Fitch................................*Registrar*

NEW MEXICO SCHOOL OF MINES

HISTORICAL SKETCH.

The New Mexico School of Mines was founded by act of the Legislature of 1889. The act provided for the support of the School by an annual tax of one-fifth of a mill on all taxable property.

Under an act of the Legislature, approved February 28, 1891, a board of trustees was appointed. Organization was effected and immediate steps were taken towards the erection of necessary buildings. In the same year a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892 a circular of information regarding the New Mexico School of Mines at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land fifty thousand acres for its support and maintenance. From this source of revenue the School has already received more than $17,000.

In 1899 the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901 the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grant of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903 the Thirty-fifth General Assembly raised the millage to forty-five one-hundredths of a mill. This, with greatly in-

creased assessed valuation of property, doubled the income of the School over that of the previous year.

Since 1903 the appropriation for the support and maintenance of the School of Mines has been increased at each session of the General Assembly. At the first session of the State Legislature the appropriation was raised to $22,500 a year.

By the terms of the Enabling Act under which New Mexico was admitted to statehood, the School of Mines becomes possessed of 150,000 acres of land. Most of this land has now been selected and will soon become the source of a very considerable revenue to the institution.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacanies shall be filled in like manner, as is provided in Sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out

the provisions of this act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said school require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mesico School of Mines is located at Socorro, the county seat of Socorro county, on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the valley of the Rio Grande at the foot of the Socorro range of mountains at an elevation of 4,600 feet above the level of the sea. The surrounding scenery is diversified by plains, valleys, mesas, hills, and mountains. The climate of the locality is pre-eminently pleasant and healthful, and has long attracted health-seekers who would escape the rigors of less favored localities. The air is exceedingly dry and the temperature is mild and equable. Socorro's public water supply comes from warm springs that issue from Socorro mountain three miles away. The water is famed for its purity and has always been an attraction to visitors and residents.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineer-

ing and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Deming, Fierra, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, smelting, lixiviation, cyaniding, and other metallurgical processes.

A number of mines of various kinds, smelters, irrigating systems, and other engineering works are accessible to the School. Within a few hours' ride by rail are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years they have yielded their wealth to the Eureopean and centuries before his advent gave up even greater treasures to the native races.

The history of modern mining schools shows that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of the world.

The School is a state institution. It was established primarily to promote the development of the mineral resources of New Mexico and to provide facilities for the young men of the state to secure a practical education in all departments of mining. Naturally, however, the institution's field of usefulness has steadily grown broader. Not only New Mexico but also other parts of the southwest have felt its influence through its graduates in the development of the mining industries of this great region. Moreover, a considerable number of students from other parts of the country who desired to avail themselves of the peculiar advantages of this region have come to the School of Mines for the training they needed and the number of such young men is constantly increasing.

During the entire period of his training the fact is impressed upon the mind of the student that intelligent mining is a business operation capable of being put on as secure a foundation as any other, that from beginning to end it is akin to all other great business undertakings, that while lucky finds will doubtless continue to be made mining is no longer to be considered a mere lottery appealing to the gambling propensities.

During the past quarter of a century the development of the mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surroundings of the School already described create an invigorating mining atmosphere which is entirely wanting in situations remote from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in those technical institutions of learning where all practical branches are equally represented, singleness of purpose is a leading feature of the New Mexico School of Mines. The conservation of energy growing out of the special

method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect under the direct supervision of his instructors various plants and works and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the state has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made under government auspices to investigate closely the geological structure of New Mexico mountains such as have been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

Much of the advanced professional work of the School is of an original nature to the end that the graduates may be skilled, theoretically and practically, in the very problems which they as professional men will be called upon to solve. This work is carried on by the advanced students under the direction of the professors and involves the collection of notes, sketches, maps, and specimens, and the results of directed observations in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining and in the reduction of the ores of lead, silver, gold, and copper are so numerous that it is impossible to do more here than to mention the

fact that the conditions of climate, drainage, water-supply, and geological structure in New Mexico differs greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigators of the ores of iron, manganese, aluminum, cobalt, nickel, tin, and quicksilver, together with the beds of coal, salt, alum, building stones, mineral-paints, cement-rocks, marls, etc., are directly in line with the advanced laboratory work of the School, and every student who undertakes such work is encouraged in every possible way to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the State with the concurrence of the Senate for a term of four years. The Board of Trustees elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them.

By act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of the state. The New Mexico School of Mines, therefore, is composed of the College and the Academy.

THE COLLEGE.

The Requirements for Admission.

Candidates for admission to the College are required to present a statement from some school of recognized standing certifying that they have completed and received a passing grade in the following subjects: Arithmetic, Elementary Algebra, Plane and Solid Geometry, ninth and tenth grade English, and one year of Elementary Physics. Those candidates who are unable to present such a statement may take an examination by the Principal of the Academy on any of the foregoing subjects to determine their proficiency therein.

Registration.

No student will be allowed to register for any subject until the pre-requisites are credited to him on the school records. Therefore the student is advised not to delay either in making up any deficiencies which may exist or in obtaining from the School the credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the Bachelor's Degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time or matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the School may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students desiring to take special courses without a view to graduation may do so provided that they give evidence of proficiency in the prerequisite subjects and that their taking such courses does not interfere with the regular schedule of classes.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

Curricula.

MINING ENGINEERING.
METALLURGICAL ENGINEERING.
MINING GEOLOGY.
CIVIL ENGINEERING.
ELECTRICAL ENGINEERING.
MECHANICAL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of either of them the Bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines who have spent two years in professional work, at least one of which must have been in a position of responsibility, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours' work in the field or in the laboratory. In the following outlined statement of curricula the number of hours per week required in the class-room and in the field or in the laboratory are given separately. The number of hours required in the field or in the laboratory represents *average* time, however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

UNIFORM CURRICULUM FOR THE FIRST YEAR.

The curriculum for the first year of the four courses offered at the School of Mines is the same in all respects. This arrangement is of advantage to the student, for it gives him until the beginning of the second year to determine for which of the four courses he is best fitted by inclination or aptitude.

Mathematics, physics, and chemistry are fundamental subjects for the successful engineer. For that reason the first year of all the engineering courses is devoted to a thorough grounding in those three subjects, as will be seen in the tabular statement below. Specialization does not begin until afterwards.

Excellent facilities are offered for the acquisition of a thorough knowledge of these subjects so necessary to successful engineering work both during the remainder of the course and during a professional career.

FIRST YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
L.	1.	Advanced Algebra	3	
L.	2.	Trigonometry	5	
I.	3.	Analytic Geometry	2	
III.	1.	General Chemistry	6	6
VIII.	1.	Shop		3
VIII.	3.	Mechanical Drawing		9
		Second Semester.		
L.	1.	Advanced Algebra	5	
I.	2.	Trigonometry	1	
I.	3.	Analytic Geometry	4	
III.	2.	Qualitative Analysis	1	9
	a.	(For Electrical and Mechanical Engineers)	1	3
	b.	(For Civil Engineers)	1	6
IV.	1.	General Surveying	3	4
VIII.	2.	Shop		3
VIII.	3a.	Mechanical Drawing (Electrical and Mechanical Engineers)		9
VIII.	4.	Machine Drawing		6
VIII.	7.	Descriptive Geometry	2	

MINING ENGINEERING.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valuing property, properly reporting propositions submitted for investment, calculating the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaptation of the steam shovel and stripping methods to western metal mines are treated at considerable length.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives detailed consideration.

FIRST YEAR.

See Page 16.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	3.	Quantitative Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	5.	Ore Analysis	1	9
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	6.	Fuel Analysis........................		3
V.	4.	Field Geology		8
V.	5.	Economic Geology....................	3	
VI.	1.	Mining A............................	3	3
VII.	2.	General Metallurgy..................	3	2
VIII.	9.	Steam Engines and Boilers...........	5	
		Second Semester.		
II.	4.	Mechanics	4	
IV.	6.	Strength of Materials...............	5	
V.	6.	Economic Geology....................	3	
VI.	2.	Mining B............................	3	
VII.	1.	Fire Assaying.......................	1	8
VIII.	5.	Machine Design......................	2	6

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism............	3	3
IV.	15.	Mine Constructions...................	3	9
V.	7.	Petrology	2	3
VI.	4.	Mine Economics	3	
VI.	6.	Ore Dressing	3	
VI.	9.	Design of Mine Plant.................		3
VII.	5.	Metallurgy of Copper.................	2	
VIII.	12.	Hydraulics	3	
		Second Semester.		
IV.	15.	Mine Constructions	3	9
V.	7.	Petrology	2	3
VI.	5.	Air Compression and Pumping..........	3	
VI.	6.	Ore Dressing	2	
VI.	9.	Design of Mine Plant.................		6
VI.	7.	Mine Administration and Accounts.....	2	
VI.	8.	Examination of Mines.................	1	3

METALLURGICAL ENGINEERING.

The aim of this four years course is to train the student for a professional career in any branch of metallurgical work. Attention is given during the first two years to such fundamental subjects as mathematics, chemistry, physics, geology, mineralogy and preliminary courses in engineering. Instruction in metallurgy proper begins in the third year, both lectures and laboratory experiments being employed for the purpose. Chemistry and geology are provided for, also. The work of the fourth year is along the line of advanced courses in metallurgy, especial attention being given to laboratory experiments, high temperature conditions of metallurgy, training in execution, and interpretation of results. Such higher branches of engineering, chemistry, and courses of importance in mining engineering claim a considerable share of attention.

The course has been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals.

FIRST YEAR.

See Page 16.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y
		First Semester.		
I	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	3.	Quantitative Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	5.	Ore Analysis	1	9
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	6.	Fuel Analysis		3
III.	9.	Electro-Analysis	1	6
V.	5.	Economic Geology	3	
VI.	3.	Elements of Mining	3	3
VII.	3.	Principles of Metallurgy	3	2
VIII.	9.	Steam Engines and Boilers	5	
		Second Semester.		
II.	4.	Mechanics	4	
IV.	6.	Strength of Materials	5	
V.	6.	Economic Geology	3	
VII.	1.	Fire Assaying	1	8
VII.	7.	Metallurgy of Iron and Steel	3	
VIII.	5.	Machine Design	2	6

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism	3	3
IV.	16.	Mine Constructions	3	9
VI.	6.	Ore Dressing	3	
VII.	6.	Metallurgy of Gold and Silver	3	
VII.	5.	Metallurgy of Copper	2	
VII.	9.	Metallurgical Plant and Design	1	3
VIII.	12.	Hydraulics	3	
		Second Semester.		
IV.	15.	Mine Constructions	3	9
VI.	6.	Ore Dressing	2	
VI.	7.	Mine Administration and Accounts	2	
VII.	4.	Metallurgy of Lead	3	
VII.	8.	Furnaces	3	
VII.	9.	Metallurgical Design		6
VII.	10.	Metallurgical Laboratory	1	8

MINING GEOLOGY.

This course extending over a period of four years is intended primarily to train men to examine, report and direct the future development of mines. In the first two years the course prescribed is similar to that of the Mining Engineering Department, so that students have a thorough training in fundamental subjects, especially in mathematics, chemistry, surveying, and other preliminary courses in engineering. In the third year the attention of the student is directed largely to geological subjects related closely to mining, namely, topographical surveying, geological surveying, petrology, and economic geology, while still continuing his studies in chemistry, mining, metallurgy, etc. The fourth year is devoted largely to advanced work in mining geology, visiting and reporting in detail on geological problems connected with ore deposition in various mining fields. Attention also is paid to the geological occurrence of petroleum.

FIRST YEAR.

See Page 16.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	3.	Quantitative Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	5.	Ore Analysis	1	9
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	6.	Fuel Analysis		3
III.	8.	Advanced Quantitative Analysis	1	6
V.	4.	Field Geology		8
V.	5.	Economic Geology	3	3
VI.	1.	Mining A	3	3
VII.	2.	General Metallurgy	3	2
		Second Semester.		
II.	4.	Mechanics	4	
III.	8.	Advanced Quantitative Analysis		6
V.	6.	Economic Geology	3	3
VI.	2.	Mining B	3	
VII.	1.	Assaying	1	8

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism	3	3
III.	10.	Physical Chemistry	2	
V.	7.	Petrology	2	6
V.	9.	Ore Genesis		6
VI.	4.	Mine Economics	3	
VI.	6.	Ore Dressing	3	
VI.	9.	Design of Mine Plant		3
VIII.	12.	Hydraulics	3	
		Second Semester.		
V.	7.	Petrology	2	6
V.	8.	Geological Examination and Surveys	2	
V.	10.	Paleontology	2	6
V.	11.	Special Problems		5
VI.	5.	Air Compression and Pumping	3	
VI.	7.	Mine Administration and Accounts	2	
VI.	8.	Examination of Mines	1	3
VI.	9.	Design of Mine Plant		6

CIVIL ENGINEERING.

This department provides a course of study in the theory and application of the principles of civil engineering. The first two years of work are substantially the same as in the other engineering courses, including practical work in drafting room and field, as well as instruction in the fundamental principles of mathematics and physics. In the third year the studies relate more directly to civil engineering. Technical courses cover the principles of structural and machine design, power and power transmission, and other fundamental engineering processes. In the drafting room the student applies those principles to the design of machines, and bridge and roof trusses. Sufficient field work is given to make the student thoroughly familiar with surveying instruments, and their use in road, mine, and railroad surveys.

FIRST YEAR.

See Page 16.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	4.	Engineering Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	
VII.	7.	Iron and Steel	3	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
IV.	4.	Railway Location	3	8
IV.	5.	Roads and Pavements	3	
V.	5.	Economic Geology	3	
VIII.	9.	Steam Engines and Boilers	5	
		Second Semester.		
II.	4.	Mechanics	4	
III.	8.	Advanced Quantitative Analysis		6
IV.	6.	Strength of Materials	5	
IV.	7.	Graphics	2	
V.	6.	Economic Geology	3	
VIII.	5.	Machine Design	2	6

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism	3	3
III.	6, 7.	Water and Fuel Analysis		6
IV.	9.	Stresses	3	
IV.	10.	Structural Details		9
IV.	11.	Water Supply Engineering	5	
IV.	12.	Masonry	5	
VIII.	12.	Hydraulics	3	
		Second Semester.		
IV.	8.	Railroad Track, Yards, Structures	3	
IV.	9.	Stresses	3	
IV.	10.	Structural Details		9
IV.	13.	Sewerage and Drainage	5	
IV.	14.	Concrete Structures	3	
VIII.	13.	Contracts and Specifications	2	

ELECTRICAL ENGINEERING.

The object of this course is to develop men who shall be competent to install and operate electric power and lighting plants. The applications of electric machinery to the working of mine plants are numerous, and are rapidly becoming more important. It is believed therefore that the electrical course outlined below is of value not only to future electrical engineers, but also to students of mining and metallurgical engineering.

In addition to a considerable amount of electrical apparatus at the School of Mines there is an electrical light plant at Socorro and an electric mine plant at Carthage. Students will have opportunities of studying the machinery in both of these plants.

The first year of the electrical course is identical with the first year of the other engineering courses of the School. The study of electricity and magnetism commences regularly in the second year. The third year requires many courses in electricity and magnetism. In this year much attention is devoted to the principal types of electric machinery. Considerable laboratory work is performed under the supervision of experienced instructors. The fourth year (which will probably not be given for a year or two) will be largely devoted to a practical study of the wide subject of design of electrical machinery.

Students desiring recommendations to the General Electric Company at Schenectady (or to any of the other large Electric Companies) will be furnished with full statements as to their work at the School of Mines and will be prepared as far as possible for the kind of electrical work that is found to be most available for them at any of the large electrical companies.

FIRST YEAR.

See Page 16.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	·3	3
II.	3.	Electricity and Magnetism	3	3
III.	4.	Engineering Analysis	1	6
VIII.	4.	Machine Drawing		6
		(Elective)	5	
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
VII.	7.	Iron and Steel	3	
VIII.	8.	Kinematics	3	3
		(Elective)	5	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	5.	Electromagnetism	3	
II.	4.	Mechanics	4	
III.	11.	Direct Current Measurements	3	3
VIII.	5.	Machine Design	2	6
VIII.	9.	Steam Engines and Boilers	5	
		(Elective)	2	
		Second Semester.		
II.	4.	Mechanics	4	
II.	6.	Alternating Current Measurements	3	6
III.	12.	Batteries, Dynamos, and Motors	3	3
IV.	6.	Strength of Materials	5	
VIII.	5.	Machine Design	2	6
VIII.	10.	Thermodynamics	2	

MECHANICAL ENGINEERING.

At present only three years of the course in Mechanical Engineering are offered, the first two years, with one or two exceptions, being practically the same as the other engineering courses and gives the student a thorough training in physics, mathematics, mechanics, and drafting. Special attention is paid to drafting, as the chief work of the Mechanical Engineer is the design of plants and machinery.

In the third year the work consists mainly of laboratory work and designing, with visits to nearby plants to observe the operation and arrangement of the different types of machines and their auxiliaries.

FIRST YEAR.

See Page 16.

SECOND YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
II.	3.	Electricity and Magnetism	3	3
III.	4.	Engineering Analysis	1	6
VIII.	4.	Machine Drawing		6
		(Elective)	5	
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
VII.	7.	Iron and Steel	3	
VIII.	8.	Kinematics	3	3
		(Elective)	5	

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week. Class.	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
II.	5.	Electromagnetism	3	
III.	13.	Direct Current Measurements...........	3	3
VIII.	5.	Machine Design.......................	2	6
		Steam Engines and Boilers.............	5	
VIII.	9.	(Elective)	2	
		Second Semester.		
II.	4.	Mechanics	4	
III.	12.	Batteries, Dynamos, and Motors........	3	3
IV.	6.	Strength of Materials.................	5	
VIII.	5.	Machine Design	2	6
VIII.	10.	Thermodynamics	2	
		(Elective)	2	

SHORT COURSE IN ASSAYING.

This course is offered for the benefit of applicants who wish to become practical assayers in as short a time as possible. No time limit is fixed for the completion of the course. Each student's preparation for the work and his ability in pursuing it will determine that matter for him. Besides the work required, students pursuing this course are permitted to elect any other courses offered which they are capable of carrying.

There are no fixed requirements for admittance to this course of study. The applicant has only to satisfy the instructor in charge of the work that he possesses the intelligence and ability necessary to carry on the work to his own advantage.

The course includes the following subjects, to be taken with the regular classes in those subjects, viz.: Elements of Chemistry, Mineralogy, General Geology, Qualitative Analysis, Quantitative Analysis, Fire Assaying, Ore Analysis.

SHORT COURSE IN ASSAYING.

Course Numbers.		Courses.	Hours per Week.	
			Class.	Lab'y
		First Semester.		
III.	1.	Elements of Chemistry	6	6
III.	2.	Qualitative Analysis		3
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
III.	2.	Qualitative Analysis	1	9
III.	3.	Quantitative Analysis	1	6
III.	4.	Ore Analysis	1	9
III.	5.	Fuel Analysis		3
V.	1.	Mineralogy	3	3
VII.	1.	Fire Assaying	1	8

DEPARTMENTS OF INSTRUCTION

I. DEPARTMENT OF MATHEMATICS.

Doctor MacKay.

The study of mathematics is emphasized as a necessary basis for the further instruction in the engineering subjects. The courses have been arranged to meet the extensive needs of students in the various branches of engineering and are intended to develop power of deduction as well as to familiarize the student with the various methods of calculation used in practical problems. Students are encouraged to use logarithms and the slide rule when the latter can be employed without too great loss of accuracy. They will also be introduced to the books of tables that facilitate calculation.

1. Advanced Algebra.

The work begins with a review of elementary algebra. This is followed by the solution of simple and quadratic equations with a large number of practical problems, the summation of arithmetical and geometrical progressions, graphical solutions of equations, vector quantities, variation and proportion, partial fractions, logarithms, inequalities, probability, abridged methods of calculation, slide rule, and limits of error.

Prerequisite: *Elementary Algebra.*

Time: Class room, three hours a week, first semester; five hours a week, second semester.

Text: Hawkes, *Advanced Algebra.*

2. Trigonometry.

A thorough knowledge of the subject matter of this course is essential for the successful carrying out of general surveying, topographic surveying, and mine surveying. It deals with the measurement of angles; the relations among the sine, cosine, and tangent of an angle; the values of the functions of multiple and fractional angles; solution of simple trigonometric equations; the solution of right and oblique triangles, involving logarithmic calculations with tables and very many practical prob-

lems; the simplest elements of spherical trigonometry. The last mentioned subject is necessary for an understanding of the methods of determining latitude and longitude, and also is essential for geodetic surveying.

Prerequisites: Elementary Algebra and Plane and Solid Geometry.

Time: Class-room, five hours a week, first semester; one hour a week, second semester.

Text: Granville, *Plane and Spherical Trigonometry with Tables.*

3. Analytic Geometry.

This subject combines the methods used in algebra and in geometry, and employs them in the study of simple curves, surfaces, and solids. It therefore affords a very good introduction to mechanical drawing, mapping, surveying, and mensuration. It deals with plotting with different systems of co-ordinates, estimation of areas, properties of systems of straight lines, circles, the parabola, the ellipse, the hyperbola, changes produced in maps by change of origin and rotation of axes, simple curves in three dimensions, surface areas and volumes of simple solids.

Prerequisites: Courses 1 and 2 of this department must accompany or precede this course.

Time: Class-room, two hours a week, first semester; four hours a week, second semester.

Text: Smith and Gale, *Introduction to Analytic Geometry.*

4. Differential Calculus.

This subject is of great importance in the study of curves, of rates of variation, of maximum and minimum values and is indispensable for the reading of most text-books of science, especially as applied in text-books on engineering. It includes limits, curve tracing and other applications of the derivative, maxima and minima, radii of curvature, summation of series, partial differentiation, solution of many problems on least cost and maximum efficiency.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Time: Class-room, five hours a week, first semester.

Text: Granville, *Elements of Differential and Integral Calculus.*

5. Integral Calculus.

The integral calculus is the most powerful weapon of calculation. It is applied in this course to the calculation of lengths of curves, areas of surfaces, volumes of solids, moments of inertia, centers of gravity, work performed by bodies moving against given forces, and many other applications to mechanics, heat, electricity and magnetism, and mensuration.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Time: Class-room, five hours a week, second semester.

Text: Granville, *Elements of Differential and Integral Calculus.*

SPECIAL AND GRADUATE COURSES IN MATHEMATICS.

Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work. The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in mathematical investigation of problems of engineering or applied science. The idea that an engineer should be a practical rather than a theoretical mathematician has guided the selection of elective and graduate courses. Students who wish to take optional work should arrange at the beginning of the college year with the head of the department of mathematics.

In addition to the foregoing, which are required of all students of engineering, the following elective and graduate courses are offered:

6. Integrals of Mechanics.

Certain types of integrals which are met with great frequency in the study of mechanics, are treated. These integrals, namely, the inertia integrals, those defining mass, and moment and center of mass, are essential in the discussion of the motion and the conditions of equilibrium of systems of particles and rigid bodies. Other integrals are studied, involving applications of mechanics to work, attraction, pressure, and centers of gravity and pressure.

Text: Lester, *The Integrals of Mechanics.*

7. Applications of the Calculus to Mechanics.

Wherever the teaching of mathematics to engineering students is discussed, and frequently in cases of other classes of students,

the criticism which is almost without exception the most insistent is this: that the student leaves the course without adequate ability to *apply* his mathematical knowledge. This means that he has not the faculty of taking a problem, giving it an analytic formulation, and interpreting the analytic results. This course is intended to supply the needed training. Students should obtain a comprehensive view of this course, partly because of the value of such a course as a means of general mental development, partly because new practical applications of discoveries in engineering are continually being made, and because no one can predict what particular facts or principles are most likely to find important practical applications in the future.

Text: Hedrick & Kellogg, *Applications of the Calculus to Mechanics.*

8. Differential Equations.

In many Colleges of Engineering, the need is felt for a course treating the subject of Differential Equations, limited in scope, yet comprehensive enough to furnish the student of engineering with sufficient information to enable him to deal intelligently with any differential equation which he is likely to encounter. To meet this need is the object of this course. This course will be found to be complete in all those portions which bear upon practical applications. Numerous applications to problems in Geometry, Physical Sciences, and Engineering are introduced.

Text: Cohen, *An Elementary Treatise on Differential Equations.*

II. DEPARTMENT OF PHYSICS AND ELECTRICAL ENGINEERING.

DOCTOR MACKAY.

The courses in physics outlined below serve to introduce students to accurate measurements identical with or similar to those which he will have to perform frequently as an engineer. In general, the experiments carried out in these courses help him to understand the physical bases for the varied methods of procedure in engineering processes. The apparatus for the course in experimental mechanics is of a very substantial character. This apparatus is well adapted for illustrating principles that lie at the foundation of an engineer's work. As in the other courses in this department, the laboratory work is accompanied by lecture room discussions and by the working out of illustrative problems. The course in heat forms an introduction to metallurgical processes especially. The course in light is introductory to much of the succeeding work in mineralogy and petrography. The elementary course in electricity and magnetism is devised for students of all branches of engineering, especial attention being paid to electrolysis and to the methods of action of simple electrical machines. The student is here introduced to the measurement and calculation of the principal electrical quantities that are met with in common engineering practice. The succeeding courses in electricity and magnetism are intended to give an opportunity for a deeper study of these subjects, and are intended especially for students who wish to specialize in electrical engineering, or in electrical machinery for mine plants, etc.

1. Experimental Mechanics.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uni-

formly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Expansion of gases; (14) Archimedes' principle; and a few other exercises if time permits.

Prerequisites: Course 2 of Department 1.

Time: Class-room, three hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Millikan, *Mechanics, Molecular Physics and Heat.*
Duff: *Physics.*

2. Heat and Light.

The first part of this course will deal with temperature, expansion, thermal conductivity, radiation, convection, change of state, and calorimetry, with simple applications to furnaces, ventilation, and heat engines. The second part of the course will deal with the laws of reflection and refraction of light, combinations of lenses, eye-pieces and objectives of microscopes, prisms, double refraction, the spectrometer, polarized light and photometry.

Prerequisites: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Text: Duff, *Physics.*
Millikan and Mills, *Light.*
Millikan, *Molecular Physics and Heat.*

3. Electricity and Magnetism.

This course deals with the elementary principles of electricity, magnetism, and the practical application of the same to dynamos, motors, lamps and electric furnaces. Qualitative experiments are performed in the lecture-room to illustrate the principal phenomena of this very large and fruitful subject. Quantitative experiments are performed in the laboratory in order to make the electrical and magnetic quantities as much as possible real quantities in the experience of the student.

Prerequisite: Course 1 of this department must precede or

accompany.

Time: Class-room, three hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Duff, *Physics.*
Silvanus Thompson, *Elementary Lessons in Electricity and Magnetism.*
Millikan and Mills, *Electricity and Magnetism.*

4. Mechanics.

The principal topics taken up are force, combinations of forces, center of gravity, moment of inertia, gravitation, stress, numerous cases of equilibrium, cords, jointed frames, friction, velocity and acceleration, harmonic motion, translation, rotation, work, energy, impulse, momentum, and very many simple practical problems with different forms of structures and machines.

Prerequisites: Courses 2, 3, 4, and 5 of Department I and Course 1 of this department.

Time: Class-room, fours hours a week, one year.

Texts: Maurer, *Technical Mechanics.*
Sanborn, *Mechanics Problems.*

5. Electromagnetism.

A discussion of the fundamental equations of electricity and magnetism; and calculation of field intensities, resistances, capacities, self and mutual induction, etc.

Prerequisites: Courses 4 and 5 of Department I and Course 3 of this department.

Time: Class-room, three hours a week, first semester.

Text: Poynting and Thomson, *Electricity and Magnetism.*

6. Alternating Current Measurements.

Measurements of magnetic permeability of various kinds of iron and steel, induction of coils, capacities, efficiency of dynamos and motors, efficiency of transformers, etc. The principal types of alternating dynamos and motors will be studied, as well as the applications of alternating currents to electric lighting and to power transmission.

Prerequisites: Courses 1 and 3 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, six hours a week, second semester.

Text: Pender, *Elements of Electrical Engineering.*

III. DEPARTMENT OF CHEMISTRY.

Doctor Kemmerer,
Frank Maloit, Jr., Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

1. Elements of Chemistry.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common elements.

The class-room work consists of lectures in which the chemistry of the elements and their compounds is simplified as much as possible. The more important reactions and theories are illustrated with lecture-table experiments and immediately following the class-room work each student performs as many experiments as possible in the laboratory, carefully recording the results. These records are then corrected by the instructor and returned to the student. At the beginning of each class hour, the students are quizzed on both class-room and laboratory work and once each week the work is reviewed in a written test.

Time: Class-room, six hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Kahlenberg, *Outlines of Chemistry.*
Kahlenberg, *Laboratory Exercises in General Chemistry.*

2. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the

laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper group are analyzed. In this manner the metals of all the groups and finally the acids are studied. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze several of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisite: Course 1 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. I.*
Baskerville & Curtman, *Qualitative Analysis.*

2a. Course 2 is given as 2a for Electrical and Mechanical Engineers.

Time: Class-room, one hour a week, second semester.
Laboratory, three hours a week, second semester.

2b. Course 2 is given as 2b for Civil Engineers.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, second semester.

3. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

The gravimetric determination of chlorine in a soluble chloride; water of crystallization in copper sulphate; iron and sulphur in ferrous or ferric sulphate; carbon dioxide, calcium, and nagnesium in dolomite; silver and copper in a dime; tin, lead, copper, and zinc in a bronze; and silica in an insoluble silicate.

The class-room work consists of lectures and quizzes in which the various analytical processes are studied from the standpoint of modern chemical theories.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. II.*
Fresenius, *Quantitative Chemical Analysis.*

4. Engineering Analysis.

The course includes some of the more important determinations in gravimetric, volumetric and electro analysis and is planned to give the engineer a general idea of quantitative analysis.

The following are some of the determinations which will be studied: Gravimetric determination of chlorine, iron, alumina, calcium, and magnesium; approximate analysis of coals; analysis of lubricating oils; heat value of coals and oils; volumetric determination of the hardness of water; the per cent purity of soda and lime; the electrolytic determination of silver and copper in a dime; analysis of iron and steel.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Text:

5. Ore Analysis.

A thoroughly practical course in the determining of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products.

Each student is required to analyze two or more ores for each of the following: Iron, copper, zinc, lead, phosphorus, calcium manganese, silica, sulphur, and arsenic. After this he will be required to accurately complete from ten to thirty determinations for any of the foregoing ores in one half day,

thereby gaining a little of the speed and accuracy necessary to every practical assayer.

Prerequisite: Course 3 of this department.
Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.
Texts: Low, *Technical Methods of Ore Analysis.*

6. Fuel Analysis.

Analysis of various coals and other fuels are made, their heat-values calculated from these analyses and also determined by means of the calorimeter. Flue-gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.
Time: Laboratory, six hours a week, seven weeks of second semester.
Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

7. Water Analysis.

Analyses of water are made in regard to their possible use in boilers. These analyses involve determination of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 3 of this department.
Time: Laboratory, last ten weeks of second semester.
Texts: Stillman, *Engineering Chemistry.*
Treadwell & Hall, *Analytical Chemistry, Vol. II.*

8. Advanced Quantitative Analysis.

This course is a continuation of Course 3 or 4. It may be substituted for Course 8. The work will be chosen to suit the needs of each student. It may consist of the complete analysis of rocks and minerals, advanced ore analysis, iron and steel analysis, cement analysis, or the determination of some of the rare elements.

Prerequisite: Course 3 of this department.
Time: Laboratory, six hours a week, one semester.

9. Electro-Analysis.

This course will deal with the practical application of the electric current in determining some of the common metals such as copper, silver, lead, and zinc. After the student has become familiar with the methods used for determining each of these, he will use the current in separating mixtures of metals and as a rapid, accurate method of ore analysis.

The course may be substituted for Advanced Quantitative Analysis, Water and Fuel Analysis, or taken as a special.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, one semester.

Text: Edgar F. Smith, *Electro Analysis.*

10. Physical and Theoretical Chemistry.

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisite: Course 3 of this department.

Time: Class-room, two hours a week, first semester.

Texts: Ewell, *Physical Chemistry.*
Jones, *Elements of Physical Chemistry.*

11. Direct Current Measurements.

This course takes up the theory of the various instruments and the practical use of the same in measuring magnetic strength, capacity, resistance, electro motive force, and current.

Prerequisites: Courses 1 and 2 of Department II.

Time: Class-room, three hours a week, first semester.

Laboratory, three hours a week, first semester.

Text:

12. Batteries, Dynamos, and Motors.

In this course the student studies theory, principal types, uses, and practical operation of primary and secondary batteries, direct and alternating current dynamos and motors.

Prerequisites: Course 12 of this department, Course 6 of Department II must precede or accompany.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Text:

13. Inorganic Preparations. (Special)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledged of inorganic chemistry is acquired.

Prerequisite: Course 2 this department.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, one semester.

14. Industrial Inorganic Chemistry. (Special)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one semester.

Text: Rogers & Aubert, *Industrial Chemistry.*

15. Organic Chemistry. (Special)

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.
Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

16. **Elements of Practical Photography. (Special)**

The course is planned to furnish the engineer with a working knowledge of photography such as will enable him to use the camera intelligently as an aid in his engineering work.

The class-room work will consist of one lecture a week which will be supplemented by laboratory work in which each student will be required to take and finish a good negative, velox print, platinum print, lantern slide, and bromide enlargement.

Time: Class-room, one hour a week, second semester.

IV. DEPARTMENT OF CIVIL ENGINEERING.

PROFESSOR COGHLAN.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the work of the fourth year the student is given instruction in Structural, Sanitary, and Hydraulic Engineering. The work which is largely drawing and design, covers practical problems, with the intent that the student may become thoroughly familiar with the principles governing his profession and with their application.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies.

1. General Surveying.

The introductory course in surveying deals with the principles of land measurement, and with the instruments used in both field and office.

In the class-room, the adjustments of the level and transit are taught, and the uses of these instruments in land surveying illustrated by practical problems.

In the field practice, each student becomes familiar with the use of the chain, tape, level, transit, etc.

Prerequisite: Course 2 of Deaprtment I.
Time: Class-room, three hours a week, second semester
Field, four hours a week, second semester.
Text: Johnson, *Theory and Practice of Surveying.*

2. Mine and Railroad Surveying.

The work consists of field work, recitations, and drafting room practice.

In the field work, a complete survey of a mining claim is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. In addition a complete survey of the underground excavations is made. Practice is also given in the laying out of railway curves and switches.

In the drafting room maps are made from the notes taken in the field practice. The value of careful work in the field and correct notes is thereby emphasized.

In the class-room, the principles of mining law are taught, and problems dealing with the connection of surface and subterranean workings are solved. The methods of computing and laying out railroad curves are studied.

Prerequisite: Course 1 of this department.
Time: Class-room, four hours a week, first semester.
Field, four hours a week, first semester.
Texts: Johnson, *Theory and Practice of Surveying.*
Allen, *Railway Curves.*

3. Topographical Surveying.

The theory and use of the stadia and other instruments used in making a topographic survey are considered, as are also the methods of topographic surveying. Some time is given to topographic drawing. A complete topographic survey based on a system of triangulation is executed, including the calculations, and platting and completing the map. Some attention is given to the precise measurement of bases and angles.

Prerequisites: Course 1 of this department.
Time: Class-room, two hours a week, second semester.
Field, four hours a week, second semester.
Text: Johnson, *Theory and Practice of Surveying.*

4. Railway Location.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, three hours a week, first semester.
Field, eight hours a week, first semester.

Text: Wellington, *Economic Theory of the Location of Railways.*

5. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways; location, construction, drainage, improvement and maintenance of country roads; various paving materials,—broken stone, brick, asphalt, wood and stone blocks, and concrete; foundations for and adaptability of each; arrangement and details of city streets.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, first semester.

Text: Baker, *Roads and Pavements.*

6. Strength of Materials.

A study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to torsion, to compression, and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moment, slopes, and deflection; overhanging, fixed, and continuous beams, flat plates, and stresses in columns and in beams subjected to tension and compression as well as bending; torsional stresses; and stresses in spring.

Prerequisite: Course 4 of Department II must accompany or precede.

Time: Class-room, five hours, second semester.

Text: Merriman, *Strength of Materials.*

7. Graphic Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 4 of Department II.

Time: Class-room, two hours a week, second semester.

Text: Merriman and Jacoby, *Roofs and Bridges, Part II.*

8. Railroad Tracks, Yards, and Structures.

Instruction is given in the methods of proper location of railroad yards to insure efficiency of operation. The details of track construction are studied. Each student makes a drawing of some railroad structure, the dimensions being of his own measurement.

Prerequisite: Course 5 of this Department.

Time: Class-room, four hours a week, second semester.

Text: Tratman, *Track.*

9. Stresses.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow, and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind, and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisite: Course 6 of this department.

Time: Class-room, two hours a week, one year.

Text: Merriman & Jacoby, *Roofs and Bridges,* Parts 1 and IV.

10. Structural Details.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering struc-

tures. Each student makes a detailed design of a steel roof truss with its supporting columns, a plate girder bridge for railroad traffic, and a highway Pratt truss span.

Prerequisites: Course 6 of this department and Course 9 of this department must accompany.

Time: Laboratory, nine hours a week, one year.

Text: Merriman and Jacoby, *Roofs and Bridges,* Part III.

11. Water Supply Engineering.

The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, methods of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours a week, first semester.

12. Masonry.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cement, wood, iron and steel. Special emphasis is placed upon the geological occurrences to the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe, and stone arches.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours a week, first semester.

Text: Baker, *Masonry Construction.*

13. Sewage and Drainage.

A study of the quantity of house-sewage and storm waters. the proper shape and dimensions of conduits for water carriage

systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours a week, second semester.

Text: Folwell, *Sewerage.*

14. Concrete Structures.

This course deals with the designing and construction of reinfoced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisite: Course 9 and 12 of this department.

Time: Class-room, three hours a week, second semester.

15. Mine Constructions.

Under the head of Mine Construction, the application of the principles of Civil Engineering to the structures most frequently required in mining is taken up. Mine buildings, bins, head-frames, trestles, crane-girders, fast-plants, tanks, etc., are studied as to form and materials of construction. The stresses produced in the members of these structures by the various kinds of loading, and the calculations of these stresses by algebraic and graphic methods are taken up.

In the laboratory the problems incident to design are solved and typical structures are designed and finished drawings made.

Prerequisites: Course 4 of Department II, and Course 6 of this department.

Time: Class-room, three hours a week, one year.
Drafting-room, nine hours a week, one year.

Texts: Merriman and Jacoby, *Roofs and Bridges,* Parts I, II, and III.
Ketchum, *Walls, Bins, and Grain Elevators.*

V. DEPARTMENT OF MINING GEOLOGY.

PROFESSOR ANDERSON.

This department aims to give its students knowledge concerning bodies of ore and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditions, so that mining may become more and more a business and that the element of chance may be lessened.

1. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals, rapid sight determination of unlabeled specimens being especially emphasized.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identfied by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral spe-

cies as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts, salts of the organic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 2 of Department III.

Time: Class-room, three hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Rogers, *Study of Minerals.*
Brush and Penfield, *Determinative Mineralogy and Blowpipe Analysis.*

2. General Geology

All the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory work in the rock collections, and in study and interpretation of topographic maps, and frequent excursions into the field. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail, training in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Limitar mountain, ten miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Prerequisite: Course 1 of this department:

Time: Class-room, two hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Chamberlain and Salisbury, *College Geology.*
Scott, *Introduction to Geology.*

3. General Geology.

Discussion of theories of earth genesis, the principles of stratigraphy, and the geologic history of the development of the North American continent, involving laboratory work with type fossils and rock collections.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Text: Chamberlain and Salisbury, *College Geology.*

4. Field Geology.

Each student is assigned a limited area within the Socorro Quadrangle. Instruction is given in the field in observing and recording geological phenomena and the preparation of map and sections. The collections made are then studied in the labora-

tory and a complete report describing the geology of the area is required.

Prerequisites: Course 3 of Department IV and Courses 1, 2, and 3 of this department.

Time: Saturdays, first semester.

5. Economic Geology.

This course embraces the study of the theories of ore deposition and the general features and formation of ore bodies and classification of ore deposits. This is followed by a description of the deposits of the ores of iron, copper, lead, zinc, silver, gold, and the lesser metals, with special reference to North America.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three hours a week, first semester.

Text: Kemp, *Ore Deposits of the United States and Canada.*

6. Economic Geology.

This course embraces the study of the non-metallic minerals of economic importance. A description of the distribution and occurrences of coal, petroleum, natural gas, asphalts, building stones, water supply, clays, cement rock, salt, gypsum, sulphur, fertilizers, abrasives, gems, and minor minerals.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three hours a week, second semester.

Collateral readings and reports on assigned topics are required of students in Mining Geology.

Time: Laboratory, three hours a week, one year.

7. Petrology.

A discussion of the origin, mineralogical and chemical composition, field classification and nomenclature, and microscopic structure of the crystalline, sedimentary, and metamorphic rocks. This is supplemented by field and laboratory work in the rock collections.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Kemp, *Handbook of Rocks and Lecture Notes.*
Luquer, *Rocks in Thin Sections.*

8. Geological Examinations and Surveys.

A discussion of the methods of systematically recording and interpreting geological phenomena, and the organization and scope of geological surveys. This is followed by a sketch of the history and results of state and national geological surveys in the United States, and of other sources of detailed information regarding local geology.

Prerequisites: Courses 1, 2, 3, 5, and 6 of this department.

Time: Class-room, two hours a week, second semester.

9. Ore Genesis.

The study of the paragenesis and origin of the minerals of a certain ore deposit. The student makes a collection of the deposit which is then studied in the laboratory by means of microscopic slides and polished surfaces and miscrochemical tests, etc.

Prerequisites: Courses 1, 2, 3, 4, 5, and 6, of this department.

Time: Laboratory, six hours a week, first semester.

10. Paleontology.

A study of the inverterbrate index fossils characteristic of the geologic horizons of North America.

Prerequisite: Course 3 of this department.

Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second seemster.

Text: Grabau and Shimer, *North American Index Fossils.*

11. Special Problems.

Research work in some branch of the science of geology, such as investigation in petrology, stratigraphy, paleontology, or ore deposits. This work may form the basis of a thesis in Mining Geology.

Prerequisites: Courses 3, 5, 6, and 7 of this department.

Time: Laboratory, five hours a week, second semester.

VI. DEPARTMENT OF MINING ENGINEERING.

PROFESSOR GRAHAM.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. The entire course is pre-eminently practical in character.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Prospecting by panning, trenches, test pits, boring and drilling. Testing of placers and ore deposits with well or chain drills.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts; quarrying.

Machine drills: Construction and operation.

Tunnelling: Methods of driving and timbering; permanent linings; sizes, speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Methods of support: Pillars, timber, filling.

Excursions are made to neighboring mines on Saturdays.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 1 of Department III.

Time: Class-room, three hours a week, first semester.

Texts: Foster *Elements of Mining and Quarrying.*
Lecture Notes.

2. Mining.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Ore extraction by systems of overhand and underhand stoping; caving by top slicing and sub-drifting; support of workings by filling and square-setting.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives.

Hoisting: Engines, drums, wire rope, skips and cages; head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Arrangements at top and underground landings: Ore pockets; signalling, etc.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiencies of fans.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, three hours a week. second semester.

Texts: Same as in Course 1.

3. Elements of Mining.

This course covers, in a general way, the work included in Courses 1 and 2 of this department. Being intended for those specializing in Metallurgy, only the fundamentals of mining are given and the student is equipped to read mining literature understandingly. In case, later, he is led into mining

work, he has the foundation upon which he can build up along the particular line in which he is interested. In this course the same trips are made that the regular students make in Course 1.

Prerequisites: Same as for Course 1 of this department.

Time: Class-room, three hours a week, first semester.

Text: Foster, *Elements of Mining and Quarrying.*

4. Mine Economics.

Among the subjects studied are: Factors governing the value of a mine; relation of labor, selling price of products, and profit; amortization of capital; ore sorting and its relation to profit; comparative efficiency of mining methods, plants, etc.; balancing the cost of mining equipments against the saving effected to see whether or not the installation is advisable.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Texts: Hoover, *Principles of Mining.*
Lecture Notes.

5. Air Compression and Pumping.

Part 1: Discussion of pumping, pump problems, and pump details. Types of Pumps: Force pumps, crank and fly wheel, direct acting, duplex, compound, and triple expansion pumps.

Part 2: A study of the action of air during compression and expansion, its flow through pipes, and also of the various types of air compressing and actuating machinery.

Prerequisites: Course 9 of Department VIII and Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Texts: Barr, *Pumping Machinery.*
Peele, *Compressed Air Plant.*

6. Ore Dressing.

This course includes a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil and acide flotation.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 12 of Department VIII must precede or accompany.

Time: Class-room, three hours a week, first semester; two hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration.*

7. Mine Administration and Accounts.

Particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of supplies, mine accounts, statement of cost, and monthly reports are discussed:

Time: Class-room, two hours a week, second semester.

8. Examinations of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside construction, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transporta-

tion to market. Full computations are required, including estimates of the cost of each process, of the necessary plant.

Time: Class-room, one hour a week, second semester.
Field, three hours a week, second semester.

9. Design of Mine Plant.

The student is assigned problems relating to a given mine. He makes the requisite surveys, plans the top-works, selects the requisite machinery for a specified duty, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or of the Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings.

Time: Laboratory, three hours a week, first semester; six hours a week, second semester.

VII. DEPARTMENT OF METALLURGICAL ENGINEERING.

PROFESSOR GRAHAM.

The aim of the Metallurgical Department is to give its graduates a thorough working knowledge of assaying, chemistry, mill-work and smelting processes; and to equip them with the knowledge necessary to the successful management of metallurgical plants, or to take charge of metallurgical operations.

This special training is given by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead: The crucible-assay of oxidized ores for gold and silver in the muffle in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assayers are considered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Course 3 of Department III, and Course 1 of Department V.
Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.
Texts: Lodge, *Notes on Assaying.*

2. General Metallurgy.

This course is intended to give the mining engineer a broad general knowledge of metallurgy. After a brief discussion on fuels, refractories, and furnaces, the various methods of roasting an ore are considered. The balance of the semester is spent in studying the theory of the process, the plant required, and the mode of operation in the reduction of each of the following metals: gold, silver, copper, lead, iron, and zinc. Visits are made to neighboring plants.

Prerequisites: Course 1 of Department II, Course 1 of Department III; and Course 1 of Department V must precede or accompany.
Time: Class-room, three hours a weekw, first semester.
Text: L. S. Austin, *Metallurgy of the Common Metals.*

3. Principles of Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

Particular stress is laid upon the study of the more recent metallurgical practices and improvements of older processes. The course is supplemented by visits to neighboring plants.

Prerequisites: Course 1 of Department II; Course 1 of Department III; and Course 1 of Department V must precede or accompany.
Time: Class-room, three hours a week, first semester.
Text: Fulton, *Principles of Metallurgy.*

4. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and Eng-

lish methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffett types of ore hearth; smelting lead ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.

Time: Class-room, two hours a week, first semester.

Text: Peters, *Principles of Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel process; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Texts: McFarren, *Cyanide Practice.*
Del Mar, *Stamp Milling.*

7. Metallurgy of Iron.

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron, gray cast-iron and spieged-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Text: Stuoghton, *Metallurgy of Iron and Steel.*

8. Furnaces.

This course is given by way of an extension of the topic "furnaces" as treated in Principles of Metallurgy. It is concerned with the theories of high temperature generation, heat conservation, measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three hours a week, second semester.

Text: Damour, *Industrial Furnaces.*

9. Metallurgical Plant and Design.

The student devotes his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two students have the same work. The working plans for part of the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bills of materials made out for the portions of the work assigned, and the cost of the several parts carefully estimated according to the trade conditions and labor factors existing at the time. The entire work and all computations are carried out according to the best engineering practice and with the same care that actual construction operations require.

Prerequisites: Course 6 of Department IV; Course 6 of Department V; Course 12 of Department VIII; and Course 2 of this department.

Time: Laboratory, three hours a week, first semester, and six hours a week, second semester.

10. Metallurgical Laboratory.

Laboratory work and investigation will be conducted along some of the following lines: Amalgamation of ores of gold and silver, chlorination of gold and silver ores, cyanidation of gold and silver ores, leaching methods for copper ores, electrolytic refining for copper and lead, slags.

Prerequisites: Courses 4, 5, 6, and 7 of this department must precede or accompany this course.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Mining and Metallurgical Trips.

During the first semester of the junior year a number of trips are taken to the mines, mills, and smelters which are within easy reach of the School. The officials at the various plants have been uniformly courteous in allowing the School the opportunity to make these visits, and have placed at the disposal of the students everything essential to a clear understanding of the mode of operation.

These excursions give the student a chance to see in operation and practice what heretofore he may have known only theoretically and give him a command of the subject that cannot be obtained in the class room.

Among the properties visited and at the disposal of the School are:

The Torrance Mine, three miles from the campus, in the Socorro Mountains. This mine was once a rich producer but is now abandoned. It is described more fully elsewhere in the catalogue.

The Merritt Mine is adjacent to the Torrance and is in process of development. It has an incline shaft equipped with gasoline hoist and self dumping skip, and a considerable amount of drifting, raises, winzes, and stopes. Practically all the operations of mining may be seen at these two mines.

The coal mines at Carthage, New Mexico, are within easy reach of the School and present to the student difficulties, and their solution, in mining, haulage, ventilation, and water supply. The use of electricity in mining is prominently brought to the student's notice.

The zinc district at Kelly, New Mexico, brings out the fact that success in mining is not all luck. There are three large mines and two mills available for inspection, and the student sees in the mines that his geology is a live subject and essential to successful mining. In the mills, he gets his first insight into ore dressing and learns that there is more than one way of doing the same thing.

The Southwestern Portland Cement Company's plant at El Paso is visited and studied from the mechanical point of view. Here are seen in action various types of crushers, grinders, elevators, conveyors, feeders, etc. The company's quarry is a fine

example of open cut mining and the student sees the uses of churn drills in drilling holes for blasting large charges.

The Rio Grande Smelting Works at Socorro, closed down twenty years ago and partly dismantled, still gives a fine opportunity to see the construction of roasters and blast furnaces, one blast furnace having been completed ready to blow in, but never used.

The New State Smelting Works, also at Socorro, is temporarily idle. It consists of a copper blast furnace and full equipment, and is within a mile of the School.

At the smelter at El Paso, the student sees the working and handling of a large custom plant. Practically everything in the line of copper, lead, and silver smelting is before him for inspection. The methods of sampling, the blast roasting of lead ores, the roasting of copper ores, the blast furnace treatment of lead-silver ores, the blast furnace treatment of copper ores, the reverberatory smelting of copper ores, basic converting, casting machines, power houses, and assay offices are all made the subject of close observation.

Once in two years, a trip, open only to students who have taken work in the Mining or Metallurgical departments, is taken through the Southwest. The probably itinerary of this trip is as follows: Santa Rita, Hurley, Morenci, Clifton, Globe, Miami, Tombstone, Bisbee, Cananea, and Douglass.

VIII. DEPARTMENT OF MECHANICAL ENGINEERING.

Mr. Hanson.

The aim of the department is to give the student a thorough training in the fundamental principles underlying engineering practice in shop-work, drafting, and field-work arranged to illustrate the principles taught in the class-room.

The School is situated near mining camps which are equipped with the large and heavier types of power and mining machinery which furnishes the student with excellent examples of modern power plant installation.

The following is a brief description of the courses offered:

1. Wood-shop.

The student is taught the use and care of wood working tools. Exercises in simple joints are then assigned and whenever possible useful exercises will be given.

Time: Work-shop, three hours a week, first semester.

2. Forging.

Exercises in drawing, shaping, upsetting, tempering, and welding. Some bench-work in chipping, filing, and rasping is also given.

Time: Work-shop, three hours a week, second semester.

3. Mechanical Drawing and Lettering.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented.

The latter part of the semester is devoted to special practice in lettering and free hand sketching.

Prerequisites: Entrance requirements.

3a. A continuation of Course 3 with special exercises in lettering, free hand sketching, and isometric projections of piping. The student is also taught tracing and blue-printing. This course is required only of Electrical and Mechanical Engineering students.

Prerequisite: Course 3 of this department.

Time: Laboratory, nine hours a week, second semester.

Text:

4. Machine Drawing.

A continuation of Course 3. Here the student makes working drawings from machine parts already made; first while having the part directly before him, and later from a free-hand sketch of the part, without having the latter to look at while drawing. He thereby becomes familiar not only with methods of dimensioning, laying out and reading working drawings but also those of making and using sketches. Through the entire course, particular stress is laid on neat lettering, correct dimensioning, and symmetrical arrangement of drawings.

The student is also taught tracing and blue printing.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, second semester.

Text:

5. Machine Design.

A study of the design of machine elements and modern machines, and of the nature, strength, and action under stress of the materials used in machine construction. Recitations are carried on, including the discussion of problems suitable for illustration of important points. In the drafting room each student completes the design of some specially assigned simple machine.

Prerequisites: Courses 3 and 4 of this department; Course 6 of Department IV must precede or accompany.

Time: Class-room, two hours a week, second semester.
Laboratory: Six hours a week, second semester.
For Electrical and Mechanical Engineering students:
Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Text: Reid and Reid, *Machine Design.*

6. Power Plant Design.

The various sources of development and transmission of power are studied briefly, together with the conditions which govern the construction of different types of machines. Steam and gas engines, gas producers, and water as sources of power are studied in detail, and a complete design with specifications and estimate of cost is worked out by the student.

Prerequisite:

Time: Class-room, three hours a week.
Laboratory, six hours a week.

Text:

7. Descriptive Geometry.

The representation of all geometrical magnitudes by means of orthographic projection, the solution of problems involving points, lines, surfaces and solids, descriptions of and problems relative to warped and double-curved surfaces, intersections of lines and surfaces.

Prerequisites: Course 2 of Department I, and Course 3 of this department must precede or accompany.

Time: Class-room, two hours a week, second semester.

Text: Church, *Descriptive Geometry.*

8. Kinematics.

A study of the various kinds of mechanical movements of machinery, such as cams, gears, links, and trains of mechanisms. Problems are assigned and worked out in the drafting room, special attention being given to the design of the different kinds of gear teeth.

Prerequisites:

Time: Class-room, two hours a week.
Laboratory, three hours a week.

Text: Barr, *Kinematics of Machinery.*

9. Steam Engines and Boilers.

In this course an elementary course in thermodynamics is given followed by the theory of the steam engine based on thermodynamics. This, in turn, is followed by a general descriptive course on engines and boilers, their types, details, construc-

tion and management. The whole course is supplemented by suitable problems to aid the student in his understanding and grasp of the subject.

Prerequisites: Courses 1 and 2 of Department II.

Time: Class-room, five hours a week, first semester.

Texts: Peabody and Miller, *Steam Boilers and Engines.*
Ripper, *Steam Engines.*

10. Thermodynamics.

A study of the laws of heat, adiabatic and isothermal expansion and temperature-entropy diagrams. This is followed by a heat study of the steam engine, gas engine, and air compressor.

Prerequisites: Courses 1 and 2 of Department II.

Time: Class-room, two hours a week, second semester.

Text: Cardulls, *Practical Thermodynamics.*

11. Heating and Ventilating.

The theory and principles of the different systems of heating and ventilating building by steam, hot air, hot water, or combinations of these systems. Calculations are made of the amounts of radiating surface required for each system and the auxiliary apparatus used with each.

Prerequisites:

Time: Class-room, three hours a week.

Text: Carpenter, *Heating and Ventilating.*

12. Hydraulics.

Under this head are treated fluid pressure, the principles of fluid equilibrium, and the laws governing the flow of water through orifices, over weirs, in closed conduits, and in open channels. The hydraulic laws relating to turbines and centrifugal pumps are briefly discussed, showing to what extent theory applies to these subjects.

Prerequisites: Course 4 of Department II and Course 6 of Dpartment IV.

Time: Class-room, three hours a week, first semester.

Text: Merriman, *A Treatise on Hydraulics.*

13. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, second semester.
Text: Johnson, *Engineering Contracts and Specifications.*

14. Mechanical Refrigeration.

This study covers the principles of producing low temperature artificially; the fluids commonly used and relative cycles of each. The ammonia compression system and the ammonia and sulphur dioxide absorption system are taken up in detail, together with the design and proportion of refrigeration and ice-making plants.

Prerequisite:
Time: Class-room, three hours a week.
Laboratory, three hours a week.
Text: Siebal, *Compend of Engineering and Refrigeration.*

15. Gas and Oil Engines.

The laws of thermodynamics of gases and their application to internal combustion, motors. Later, the design and construction of the different types of engines is taken up.

Prerequisites:
Time: Three hours a week.
Text: Hutton, *Gas and Oil Engines.*

IX. DEPARTMENT OF LANGUAGES.

PROFESSOR DRAKE.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge, for in Socorro and vicinity Spanish is as generally spoken as English.

1. Spanish. (Optional)

The work is based on Worman's First and Second Spanish Readers. A part of the class exercise each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language with the idea of learning the grammar from the language rather than the language from the grammar.

Time: Two hours a week, one year.

Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish. (Optional)

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar* being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.

Time: Two hours a week, one year.

ACADEMIC DEPARTMENT.

Professor Smith.

The requirements for admission to the Academy are the same as those for standard secondary schools. A two-year course is offered, the work therein corresponding to that of the ninth and tenth grades of the standard high school.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

FIRST YEAR—FIRST SEMESTER.

Elementary Algebra.

To the subject of simultaneous linear equations, including the four fundamental operations; factoring, including the determination of the highest common factor and the lowest common multiple; linear equations; and problems depending on linear equations.

Time: Five hours a week.

Text: Hawkes, Luby, and Touton, *Complete School Algebra.*

English I.

The Idyls of the King and The Lady of the Lake are read and discussed in class. The memorizing of some of the most significant passages is required. In composition work, an attempt is made to interest the student at once in narrative writ-

ing, fluency and correct expression being sought primarily. Later in the year the work verges into exposition. During the semester, suitable selections from the best literature, both classic and modern, are read as supplementary to the above.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physiography.

Wherever possible, in this course, facts obtained by actual observation are made to verify and supplement the text used. There are daily assigned observations of clouds, winds and temperature. A study of erosion by wind and water and of geologic formation is made. In connection with the study of stream-flow, attention is called to the great importance of forest preservation to the people of the West.

Time: Five forty-five minute periods a week.

Text: Dryer, *High School Geography.*

FIRST YEAR—SECOND SEMESTER.

Elementary Algebra.

Radicals, including the extraction of square root; exponents, including the fractional and negative; quadratic equations and problems depending on them, and the binomial theorem for positive and negative exponents.

Time: Five hours a week.

Texts: Wells, *Algebra for Secondary Schools.*
Hawkes, Luby, and Touton, *Complete School Algebra.*

English I.

In this subject, the work of the first semester is continued. The Merchant of Venice and Hamlet are read and discussed in class. As in the first seemster, appropriate supplementary matter is read by each pupil.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physiography.

The work during the second semester is a continuation of that of the first. Notes are kept by each pupil, during the year, based on the text, and on practical observation and research.

Time: Five forty-five minute periods a week.
Text: Dryer, *High School Geography.*

SECOND YEAR—FIRST SEMESTER.

Plane Geometry.

The work in this subject for the first semester covers the usual theorems and constructions of good text books, including the general propositions of plane rectilinear figures; the circle and measurement of angles; similar polygons; areas; regular polygons, and the solution of numerous original exercises.

Time: Five hours a week.
Text: Wentworth and Smith, *Plane Geometry.*

English II.

During the first semester of the second year, Shakespeare's Tempest and George Eliot's Silas Marner are read and discussed in class. The work in composition and rhetoric is continued, including a study of the most important forms of prose and poetry, versification, and figures of speech.

Time: Five forty-five minute periods a week.
Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physics.

This course runs throughout the entire year, the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. During this semester the subjects of mechanics, sound, and light are studied.

Time: Five hours a week.
Text: Carhart and Chute, *High School Physics.*

History.

For the benefit of those who have not had the opportunity to study Ancient History a brief review of that subject is made. Grecian and Roman History are given their proper emphasis. Special attention is paid to the History of Western Europe since the barbarian invasion, with emphasis on the bearing of old-world events upon the history of the Americans. In the study of such things as the mediaeval town, life in the feudal castle

and the Renaissance, an attempt is made to cause the student to realize these things as aspects of the daily existence of common men and women, which he would have lived likewise under like conditions, rather than to obtain a fixed mental chronology of dates and occurrences. Frequent written reviews are given throughout the course.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

SECOND YEAR—SECOND SEMESTER.

Solid Geometry.

The work for the second semester includes the usual theorems and constructions of good text books covering the relations planes and lines in space; the properties and measurements of prisms, pyramids, cylinders, and cones; the sphere; and the spherical triangle.

Time: Five hours a week.

Text: Wentworth and Smith, *Solid Geometry.*

English II.

During the second semester of the second year Julius Caesar and Milton's Minor Poems are read and discussed in class. A careful study of the history and development of English literature is made. Extracts from the classics are read and discussed. Notes are kept based on the text studied.

Time: Five forty-five minute periods a week.

Text: Long, *English Literature.*

Physics.

This is a continuation of the first semester's work. Heat and electricity are treated in much the same manner as the subjects of the first half of the year.

Time: Five hours a week.

Text: Carhart and Chute, *High School Physics.*

History.

This is a continuation of the first semester's work.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus contains 20 acres of nearly level ground on the outskirts of the city of Socorro. Groves of trees have been planted and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet deep, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite in broken ashler and is trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated, heated with a good hot-water system, piped for water and gas, and wired for electricity for illumination and for experimental purposes.

As now arranged the main floor of this building contains the president's office, the mineralogical museum, the qualitative chemical laboratory and instructor's office, the assay laboratory and balance rooms, and a lecture room. The basement contains two lecture rooms, the physical laboratory, and instructor's private mineralogical laboratory, the quantitative chemical laboratory, the electro-chemical laboratory, an instructor's private chemical laboratory, the chemical supply rooms, a photographic dark room, the boiler room, the engine room, the hot water heating plant, and the lavatories. A lecture room, now occupied by the department of mathematics, is located on the second floor. The main library occupies the third floor.

Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion the building is to be X-shaped, the central pavilion two stores and the four wings one story. With its spacious rooms it will be peculiarly adapted to engineering instruction.

When the building is completed the entire north wing will be devoted to draughting purposes, the light coming from above. At present the main draughting-room is in the south wing which also is a lecture room. Off this are the instructor's office and a blue-print room. A photographic room is fitted up in the main building.

Dormitory.

The School of Mines suffered long for lack of dormitory accommodations. In fact, it is known that many students who would otherwise have come to the School of Mines in years past went to other institutions because of the lack of the lower cost of living which a dormitory here would have afforded. However, the $15,000 generously appropriated by the territorlial legislature was expended with the result that the School of Mines is equipped with what is probably the best dormitory in New Mexico. The building is heated with hot water and lighted with electricity. There are a dining room and kitchen in connection, also a bath room on each of the two floors and a shower bath in the basement. The assembly room, on the first floor, which is now equipped for the accommodation of the academic department, promises to meet all the requirements of that department for some time to come. The building is designed to afford accommodations for about thirty students and from time to time has been occupied to practically its full capacity.

Students are accommodated with board and lodging at the dormitory at the rate of $20 a month, they being required to furnish only their own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself, and no student will be accommodated in this way to the exclusion of another student from dormitory privileges. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture. After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application.

EQUIPMENT.

Chemical Laboratories.

The chemical laboratories have recently been greatly enlarged and improved. As now arranged they occupy the entire south wing of the main building, while the store room, private laboratory, and chemical lecture room are located in the central section of the same building. Elements of chemistry and qualitative analysis are taught in the large laboratory on the main floor. The room, which is exceptionally well lighted and ventilated, is equipped with large hoods, a balance room, and twenty-four desks, each of which is supplied with gas, water, and electric light.

The basement laboratory has recently been remodeled and fitted with large windows, glass partitions, and modern desks. The east half of it used for quantitative analysis and wet assaying. There are large hoods in each end which are supplied with hot plates and drying ovens, while each desk is equipped with an Alberine stone sink, water, gas, and electric light.

In the west half of the basement there are the instructor's laboratory, electro-chemical laboratory, and balance room. The latter is fully equipped with the best analytical balances supported upon a solid concrete table which is entirely free from vibration. The electro-chemical laboratory is supplied with current from a modern storage battery plant, consisting of a motor-generator, storage cells, and a switch-board so arranged that each student may obtain any current he desires for analytical or other electro chemical experiments. There is also a supply of alternating current from the city circuit which is used for light and small electric furnaces.

The laboratory is very completely equipped not only with all apparatus, chemicals, and supplies needed for the various courses, but the stock includes a large amount of pure chemicals and special apparatus, including standardized burettes, flasks, and weights which are used for the most accurate rock analysis and research work.

All apparatus is loaned to the students. Chemicals and supplies are furnished at cost.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types and large muffle coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes, and other assaying materials and supplies.

A weighing-room containing a number of Becker's balances is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher and a Bolthoff sample-grinder and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers, and other necessary apparatus.

Physical Laboratory.

The physical laboratory occupies the north end of the north basement of the main building and contains the usual apparatus for illustrating the facts and laws of physics. In addition there has just been added at a considerable expense all the apparatus necessary to perform the quantitative experiments outlined in Course 2 of Department II.

Petrographical Laboratory.

For the microscopic study of rocks both in elementary and advanced or graduate work the School is well supplied with rocks in thin sections representing the various types of igneous, metamorphic, and sedimentary rocks accompanied by hand specimens, giving the student an opportunity to study the microscopic and megascopic characters of the rocks at the same time. The laboratory is well equipped with standard up-to-date microscopes with all accessories; also, a camera for microphotographic work with accessories for oblique and vertical illumination; also, a rock slicing machine with electric power attachment where the students in petrography are taught how to make and mount thin sections.

Mineralogical Laboratory.

For the study of minerals by physical characters and blow pipe test, the School is especially well provided with an abund-

ance of material of various ores and minerals for blow pipe determinations. Large collections for this purpose have recently been added to the School and the minerals are so arranged that no two students work with the same minerals the same day, thereby stimulating thorough systematic search for the elements and correct determination of the mineral specimens. The laboratory is well equipped with all necessary apparatus to carry on this work in an efficient and up-to-date manner.

Mineralogical Museum.

The Mineralogical Museum, with instrcutor's office, occupies the entire north wing of the first floor of the main building. The School owns a very fine collection of minerals and rocks of all kinds. These are arranged systematically, forming units for the various courses in Geology rather than for showy display. The minerals and rocks from the various mining districts are segregated, thereby giving the students the best possible opportunity of studying the ores and rocks of a district without having actually visited the field. The Museum is well supplied with such district collections throughout the United States, Mexico, and Canada.

ENGINEERING INSTRUMENTS.

The Civil Engineering Department has all the instruments necessary for land, railroad, irrigation, mine, and topographic surveys. These include chains, tapes, range-poles, level rods, wye and dumpy levels, complete transits, and plane tables. In purchasing instruments for this department only the best grade has been considered and the student has the opportunity to become familiar with the product of such well known manufacturers as Gurley & Sons, Eugene Dietzgen, Buff & Buff, etc.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the engineering building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame on steel track, developing-vat, and drying rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. An Ingersol-Rand drill and other pieces of machinery are used as models.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats, and atlases, and volumes on history, travel, and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.
Mining and Scientific Press.
Engineering Record.
Power.
Engineering News.
Mining Science.
Mines and Minerals.
Engineering Magazine.
Journal of the American Chemical Society.
Journal of Industrial and Engineering Chemistry.
Chemical Abstracts.
Review of Reviews.
Economic Geology.
School of Mines Quarterly.
New Mexico Journal of Education.
All the U. S. G. S. Publications.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions and author's separates, pertaining to the respective divisions.

..*Powell Library.*—The School has come into possession of the private library of the late Major John W. Powell of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology, and philosophy, many of which are rare and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work

which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who has been so long identified with this western country, should find a permanent home in New Mexico.

THE TORRANCE MINE.

The Torrance gold and silver mine at the base of Socorro mountain, only about two miles from the School campus, affords excellent opportunities for the practice of mine-surveying and for a study of some features of practical mining. The opening is a double-compartment incline shaft, timbered, with various levels, cross-cuts, winzes, shafts, and stopes. The ore-bodies with associated geological structures and many other features will interest the student of mining engineering.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is twenty-five dollars a semester except to citizens of New Mexico, the tuition fee for the latter being ten dollars a semester. This is payable at registration and its payment after matriculation admits the student to all class-room instruction. Students who hold scholarships pay no fee for tuition.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water, and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Quantitative Analysis, Water and Fuel Analysis, Inorganic Preparations, Organic

Chemistry, Electro-Analysis, Photography, Physics, each $5.00; Qualitative Analysis, Ore Analysis, each $7.50; Fire Assaying, $10.00; Mineralogy (Blowpipe Analysis) $3.00; Metallurgical Laboratory, $3.00; Mine examination, $1.00.

A deposit of $2.00 is required from each student who registers for any of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due from the breakage of apparatus.

Graduation Fee.

The graduation fee, payable after delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer	$10.00
Bachelor of Science	5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month; board at the hotels and best boarding-houses for $7.00 a week. The cost of living at the dormitory is $20 a month.

Books and Other Supplies.

Books and other supplies for students are furnished through the office at publishers' prices with the freight or express charges added. A considerable saving is thus made in behalf of the student.

Summary of Annual Expenses.

A close approximation of a student's necessary annual expenses is tabulated below. By the practice of extreme economy a student may, of course, cut his expenses somewhat below the figures here given.

Board and room at the dormitory	$180.00
Books and other supplies	60.00
Laboratory and other fees	25.00
Total	$265.00

SCHOLARSHIPS AND PRIZES.

Scholarships.

Through the generosity of the members of the Board of Trustees, of the Thirty-seventh General Assembly of New Mexico, and

of the Allis-Chalmers Company, the New Mexico School of Mines has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

School of Mines State-Scholarships.—To one student from each state of the Union is open a scholarship yielding free tuition. Each scholarship may be held for one year and is assigned to that applicant who shows the greatest proficiency in subjects already pursued by him. Application must be made in writing to the President and in the case of those who have not been students in the School must be accompanied by a certified statement of subjects pursued and the grades received therein unless the applicant prefers to pass an examination in the subjects for which he seeks credit.

School of Mines County-Scholarships.—Scholarships are open to two students from each county in New Mexico. These scholarships yield free tuition and are subject to the same conditions as the State-Scholarships.

New Mexico Scholarships.—The Thirty-seventh General Assembly of New Mexico gave to each representative, to each councilman, and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the territory and provided an appropriation of $200.00 for each appointee.

Allis-Chalmers Scholarship.—To one member of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opportunity for four months' study and employment in any of its plants and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Prizes.

The Brown Medal.—Hon. C. T. Brown of Socorro offers annually a gold medal to the student who, while doing a full

year's work, has shown the greatest proficiency in the courses in Wet Assaying and Fire Assaying. The medal is awarded each year at commencement. Only those students are eligible as contestants for the medal who at commencement are found to have completed the courses named and, of course, the prerequisites to these courses.

In case of a tie in the grade of proficiency between two or more contestants, special specimens of ore are subimtted to them for assaying, until the tie is broken.

SUMMER WORK.

The proximity of the School to mineral properties, mines, and smelters makes it easy for the student to secure employment during the summer (and during the Christmas vacation, if desired) and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining, have been attractive fields of work for the students during the vacations.

DEGREES.

The degrees of Bachelor of Science, Mining Engineer and Civil Engineer are conferred by the Board of Trustees upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of the institution, have completed the prescribed collegiate courses of any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satis-

factory evidence of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed courses of the four-year curriculum in Mining Engineering, Metallurgical Engineering, or Mining Geology, has presented an original and satisfactory dissertation in the line of his work, and has done two years of professional work of which one has been in a position of responsibility. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum, and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the Mining Engineer, except that the candidate substitutes, in some of his later work, courses which relate more directly to the profession he expects subsequently to follow.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but in each case the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidence of independent investigation to warrant its publication in whole or in part.

CHEMICAL ANALYSIS, ASSAYING, AND ORE TESTING.

The wide demand which exists in the great mining district of the Southwest for disinterested and scientific tests and practical investigations has led to the establishment by the New Mexico School of Mines of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible and accurate results assured by reason of the exceptional facilities of the laboratories of the School and the extensive practical experience of

the instructors. The rapidly increasing amount of this work intrusted to thee School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines." By special resolution it is required that all charges shall be paid in advance.

Commercial Assaying.—The assaying for gold, silver, copper, lead, zinc, and the common metals is carried on in all its various phases. All work is run in duplicate and, in case of any non-concordant results, such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese, and the rarer metals such as uranium, vanadium, nickel, and cobalt are made according to the best methods.

Water Analysis.—The chemical analysis of waters for city-water supplies, boilers, and domestic use, and of mineral and mine-waters has of late assumed great importance. The chemical laboratory of the School is fully equipped for this work and in the case of bad waters remedies and methods to be used to improve the waters for specific purposes are suggested. A large number of analyses of waters from the Southwest have already been made and very interesting results obtained.

Fuel Analysis.—Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coal regions. Complete analyses and heat tests have been made of some of the principle deposits. With the work already done the results of new analyses are made of special value on account of the comparative figures that can be supplied. All heat values are determined with an Emerson Bomb Calorimeter.

Oil Analysis.—Testing crude oil. The usual tests are for water, sediment, heat value, and fractionation into the various burning and lubricating oils.

Burning oils are also tested for flash point, burning point, heat value, and specific gravity.

Lubricating oils are tested for specific gravity, flash point. viscosity, cold point, acidity, evaporation, and per cent of animal or vegetable oil.

Prices for any of the above will be sent on application.

Clay, Fire Clay, and Fire Brick Testing.—The laboratory is equipped to carry out the following: Complete chemical analysis including the various forms in which the silica may be combined; melting point of clay or brick in electric furnace; baking test of clay, specific gravity, and absorption and constituents soluble in water or any solution.

Melting point of fire clay or brick	$10.00
Baking test of clay	5.00
Specific gravity and absorption of brick or stone	3.00

Other prices will be sent on application.

ORE TESTING.

Amalgamation Tests.—The laboratory is now well equipped to carry out the amalgamation test on small samples of ore. This will include grinding the ore to any size and shaking it with mercury where the sample is small (under 10 pounds), while larger samples will be treated in a pierce Amalgamator which has been especially constructed for such tests. The prices include assay of the tails and concentrates.

Cyanide Testing.—The laboratory is well equipped to carry out all of the usual cyanide tests. These include the extraction of the sample crushed to any desired size, with any strength of cyanide solution, either by agitation or percolation; the determination of alkali necessary to neutralize ore; the determination of cyanide consumed; and the determination of gold and silver before and after treatment.

The School will be glad to correspond with any one wishing other extraction or treatment tests.

Blowpipe Tests, Etc.—Determination of rocks and specimens by inspection is made without charge. When a satisfactory determination cannot be made by inspection, a charge of $1.00 to $2.00 is made for an approximate analysis by blowpipe tests.

For an approximate analysis and determination by the microscope, a charge of $3.00 is made. This includes the cost of the thin sections.

TABLE OF PRICES FOR
CHEMICAL ANALYSIS, ASSAYING, AND ORE TESTING.

Complete qualitative analysis	$5.00 to $15.00
Copper, lead, iron, insoluble residue, each	1.00
Gold or silver (fire), each	1.25
Gold and silver	1.50
Zinc, calcium, each	1.50
Magnesium, sulphur, manganese, each	2.00
Barium, strontium, true silica, mercury, each	3.00
Aluminum, tungsten, chromium, each	3.50
Cadmium, tin, arsenic, bismuth, antimony, potassium, titanium, sodium, uranium, or phorphorus, each	4.00
Nickel, cobalt, molybdenum, vanadium, indium, carbon, lithium, nitrogen, platinum metals, each	5.00
Clay complete	15.00
Cement analysis (chemical)	15.00
Water analysis (not including organic compounds)	25.00
Boiler water	10.00
Coal (approximate)	5.00
Coal, including sulphur and phorphorus	7.50
Flue gas	2.50
Heat value of coal (Bomb Calorimeter)	5.00
Complete rock analysis, per determination	2.00
Amalgamation test, samples not over 10 pounds	8.00
Amalgamation test, samples 11-25 pounds	10.00
Amalgamation test, samples 26-100 pounds	15.00
Cyanide test, 2 to 5 pound samples, including extraction with one solution, crushed to one size, alkali required cyanide consumed, gold and silver before and after treatment	10.00
Treatment with each additional solution and size	2.00

Prices for larger quantities will be sent on application.

3 to 5 samples for the same determination, 10 per cent discount.

6 or more samples for the same determination, 25 per cent discount.

Prices for any other analysis or test will be sent on application.

The accuracy of all the above tests and analysis is guaranteed within the accepted limit of error. All work is carried out by members of the faculty. No student work is permitted.

DIRECTORY OF GRADUATES AND STUDENTS

DIRECTORY OF GRADUATES AND STUDENTS†

ARTHUR H. ABERNATHY — Mapimi, Durango, Mexico.

Student, 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, Cananea, Sonora, Mexico, 1901; Assistant sampleman, Minera de Penoles Company, Mapimi, Durango, Mexico, 1909-1910; Sampling foreman, same company, 1910—.

ANTONIO ABEYTA

Entered 1908, from Socorro, New Mexico. Candidate for B. S. degree in Metallurgical Engineering.

GEORGE C. BAER — Mogollon, New Mexico.

(B. S. in Mining Engineering, New Mexico School of Mines, 1910.)

Student, 1907-1910. From Hillsdale, Michigan. Assayer, Tri-Bullion Company, Kelly, New Mexico, 1910; Millman, Socorro Mines Company, Mogollon, New Mexico, 1911; Mill foreman, same company, 1912; Engineer, same company, 1912—.

C. E. BARCLAY — Maria, Texas.

(A. B., University of Virginia.)

Student, 1896-1897. From Bowling Green, Kentucky.

JAMES HENRY BATCHELDER, Jr. — Socorro, New Mexico.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)

Student, 1906-1910. From Exetor, New Hampshire. Mining, Chloride, New Mexico, 1911.

THOMAS HORTON BENTLEY — Calgary, Alberta, Canada.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)

Student, 1907-1910. From Burro Mountains, New Mexico. Surveyor with Mildon & Russell, Nacozari, Sonora, Mexico, 1910; General engineering work, Hermosillo, Sonora, Mexico, 1911; Mining engineer, Portland, Oregon, 1911; Assistant superintendent, Norton Griffiths Steel Construction Company of London, England, with headquarters at Vancouver, British Columbia, Canada, 1912; Superintendent, same company with headquarters at Calgary, Alberta, Canada, 1912—

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†Information concerning former students not here listed or concerning changes of address of those already listed will be gladly **received.**

IGNATIUS LOYOLA BERRIEN

Entered, 1911, from El Paso, Texas. Sophomore class.

JAMES FIELDING BERRY Angangueo, Michiocan, Mexico.

Student, 1904-1905. From Socorro, New Mexico. Assayer, American Smelting & Refining Company, Aguascalientes, Mexico, 1905; Assayer, City of Mexico, Mexico, 1906-1907; Chemist, Cia Metalurgica y Refinadora del Pacifico, Fundicion, Sonora, Mexico, 1908; Assistant mine superintendent, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1909—.

LOUIS AUGUST BERTRAND Upland, Nebraska.

Student, 1895-1896. From Conway, Iowa. Student, Ecole Professionella de l'East, Nancy, Lorraine, 1890-1894. Instructor in Mathematics and French, New Mexico School of Mines, 1895-1896; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and surveyor, Consolidated Kansas City Smelting & Refining Company, Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Mine superintendent, Minera de Penoles Company, Mapimi, Durango, Mexico, 1901.

MAURICE BREEN

Entered, 1912, from El Paso, Texas. Academic Department.

CONY C. BROWN

Entered, 1908, from Socorro, New Mexico. Special.

JOSEPH BROWN, Jr.

Entered, 1912, from Kelly, New Mexico. Academic department.

H. LAWRENCE BROWN. Los Angeles, California.

Student, 1903-1905. From Chicago, Illinois. Positions: Assayer, Ernestine Mining Company, Mogollon, New Mexico; Engineer, Cia Concheno Beneficiador, Mexico; Mill superintendent, Milwaukee Gold Extraction Company, Phillipsburg, Montana; Engineer, Transvaal Copper Company, Sonora, Mexico; Manager, Morning Star Mining Company, Ophir, Colorado; Manager, San Carlos Mining Company, Sonora, Mexico; Manager of six properties and consulting engineer, Cobalt, Ontario, Canada; Superintendent, Haile Gold Mine, Kershaw, South Carolina; Exploration work in Venezuela, South America; Mill superintendent, National Mining Company, National, Nevada; At present, mining engineer with the American Metal Company with headquarters at Los Angeles, California.

THOMAS COBURN BROWN

Entered, 1910, from Socorro, New Mexico. Special.

CHAUNCEY E. BUTLER*

Student, 1893-1894. From Kelly, New Mexico. Assayer, Cibolo Creek Mill & Mining Company, San Francisco, California, 1896; Assayer and furnace superintendent, La Compania Minera Lustre, Magistral, Durango, Mexico, 1897-1898; Chemist and assayer, United Verde Copper Company, Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Company, and Jenny Lind and Maple Mining Company, Dedrich, California, 1903.

BEONARD M. BUTCHOFSKY

Entered, 1912, from El Paso, Texas. Academic department.

PHILLIP A. CAMPREDON

Entered, 1910, from Socorro, New Mexico. Junior class.

R. HARLAND CASE — Deming, New Mexico.

Student, 1902-1905. From Cerrillos, New Mexico. Chemist, Compania Metalurgica de Torreon, Coahuila, Mexico, 1905-1906; Assistant superintendent, Bonanza Mines, Zacatecas, Mexico, 1906; Assistant manager, Stephenson-Bennett Mining and Milling Company, Organ, New Mexico, 1906-1907; Consulting engineer, Western Mining, Milling & Leasing Company, Colorado Springs, Colorado, 1907-1908.

EDWARD C. CHAMNEY — Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-1901; Assayer, Oro Mining Company, Minnehaha, Arizona, 1901.

VIVIAN V. CLARK — Seattle, Washington.

Student, 1896-1898. From Kelly, New Mexico. Assayer, Bland Mining Company, Bland, New Mexico, 1898-1899; Superintendent, Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine operator, Albuquerque, New Mexico, 1902; Manager Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903-1908; Consulting engineer, Consolidated Exploration Mines Company of New York, and allied syndicates, 1909-1910; President, Northern Engineering Company, Seattle, Washington, 1910-1912; President, Clark Mining Machinery Company, successors to Northern Engineering Company, 1912—.

DAVID JOSHUE CLOYD — Saltillo, Coahuila, Mexico.

Student, 1899-1900. From Decatur, Illionois. Chemist and assayer, Wardman's Assay Office, Aguascalientes, Mexico, 1900-1906; Assistant superintendent, Cia. Minera del Tiro General, and assist-

*Deceased.

ant superintendent, Cia. del Ferrocarril Central de Potosi, Charcas, San Luis Potosi, Mexico, 1906-1908; Assayer and chemist, Dailey, Wisner & Company, Torreon, Coahuila, Mexico, 1908; Chief assayer and chemist, Mazapie Copper Company, Saltillo plant, Saltillo, Coahuila, Mexico, 1911—.

SAMUEL COCKERILL Indianapolis, Indiana.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-1906. From North Fork, Virginia. Post-graduate engineering course, Allis-Chalmers Company, 1907-1908; Milwaukee Coke and Gas Company, Milwaukee, Wisconsin, 1908-1910; Citizens Gas Company, Indianapolis, Indiana, 1910—.

WALTER ALFRED DAVENPORT

Entered, 1912, from Nashville, Illinois. Special.

JOHN F. DEMPSEY

Entered, 1912, from Santa Rita, New Mexico. Academic department.

LEON DOMINION New York, New York.

(B. A., Roberts College, Constantinople, 1896; C. I. M., Mining School, University of Liege, 1900.)

Graduate student, 1903-1904. From Constantinople, Turkey. Assistant, United States Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-1904; Engineer, Victor Fuel & Iron Company, Denver, Colorado, 1904-1906; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-1907; Consulting Engineer, Mexico City, Mexico, 1908-1909; Consulting engineer, New York City, 1910.

MARJORIE DOUGHERTY.

Entered, 1913, from Socorro, New Mexico. Academic department.

ROBERT CASIANO EATON*

Student, 1893-1894. From Socorro, New Mexico. Sampling mill foreman, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1894-1898; Superintendent, Muriedas Smelting Works, Xichu, Guanajuato, Mexico, 1898; Superintendent, Pozo del Carmen Ferrocarril, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager, Nuevo Cinco Senores Mining and Milling Company, Camanja, Jalisco, Mexico, 1902-1904; Independent assayer and ore buyer, Leon, Guanajuato, Mexico, 1904-1910.

*Deceased.

ALEXANDER WALTER EDELEN Angangueo, Michiocan, Mexico.

Student, 1905-1906. From Baltimore, Maryland. Assistant superintendent, Elkton Consolidated Mining & Milling Company, Elkton, Colorado, 1906-1907; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1907-1908; Mine superintendent, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1909—.

ALDERSON BURGHR EVERHEART

Entered, 1912, from Bells, Texas. Special.

THADDEUS BELL EVERHEART Socorro, New Mexico.

Student, 1905-1907. From Bells, Texas. Assayer and surveyor, Pereguina Mining and Milling Company, Guanajuato, Mexico, 1907-1908; Mill superintendent, Las Animas Mining and Milling Company, Pueblo Nuevo, Durango, Mexico, 1908-1910; Mining, Chloride, New Mexico, 1911.

LEOPOLD E. FLEISSNER Milwaukee, Wisconsin.

(B. S., E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1910-1912. From Manistee, Michigan. Engineer, Sterling Engineering & Construction Company, Milwaukee, Wisconsin.

JOHN ELMER FULLERTON

Entered, 1912, from Datil, New Mexico. Special.

HARRY THORWALD GOODJOHN Torreon, Coahuila, Mexico.

Student, 1902-1903. From Pittsburg, Texas. Assayer, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1903-1906; Chief chemist, Minera de Penoles Company, Mapimi, Duranga, Mexico, 1906; Chemist and metallurgist, Cia. Minera, Fundidora, y Afinadora, Monterey, Mexico, 1907-1908; Chief chemist, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1909—.

SAMUEL JAMES GORMLEY West Jordan, Utah.

Student, 1895-1896. From Mt. Vernon, Iowa. Assistant professor of Engineering, New Mexico School of Mines, 1895-1896; Assistant assayer, Anaconda Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist, same company, 1900-1902; Superintendent of sampling works, Washoe Smelting Company, Anaconda, Montana, 1902-1906; Smelter superintendent, Bingham Copper & Gold Mining Company, West Jordan, Utah, 1906.

EDWIN CLARENCE HAMMEL

Entered, 1912, from Socorro, New Mexico. Academic department.

HENRY ROOT HARRIS

Entered, 1908, from Socorro, New Mexico. Candidate for B. S. degree in Mining Engineering.

MARJORIE HERRICK

Entered, 1912, from Socorro, New Mexico. Academic department.

ROSEMARY HILTON

Entered, 1912, from Socorro, New Mexico. Academic department.

RUE N. HINES*

(B. S., New Mexico School of Mines, 1907.)

Student, 1904-1907. From Socorro, New Mexico. Superintendent West Coast Mining & Smelting Company, Mocorito, Sinaloa, Mexico, 1907-1909; Locating and developing prospects in Arispe District, Sonora, Mexico, 1910; Secretary, First Mortgage & Security Company, El Paso, Texas, 1911.

INNOKENTY J. HLEBNIKOFF

Entered, 1912, from Blagoveshensk, Russia. Special.

EDMUND NORRIS HOBART Charcas, San Luis Potosi, Mexico.

(B. S., New Mexico School of Mines, 1910.)

Student, 1906-1908, 1909-1910. From Clifton, Arizona. Chemist, Socorro Mines Company, 1909; Chief sampleman, Shannon Copper Company, Clifton, Arizona, 1910-1911; Assistant surveyor, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1911; Resident engineer, Capistante Mines Group, Mazapil Copper Company, Limited, Concepcion del Oro, Zacatecas, Mexico, 1912; Chief engineer, Charcas Unit, American Smelting & Refining Company, Charcas, San Luis Potosi, Mexico, 1913—.

ANTON HOGWALL Nogal, New Mexico.

Student, 1898-1899. From White Oaks, New Mexico. Assayer, Buckeye Mining Company, Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Company, and Helen Rae Mining Company, White Oaks, New Mexico, 1901; American Gold Mining Company, Nogal, New Mexico, 1902.

CARL JOHN HOMME Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate student, 1899-1900. From Wittenburg, Wisconsin. Assayer and chemist, Candelaria Mining Company, El Paso, Texas, 1900-1901; Assistant superintendent, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902.

*Deceased.

WILLIAM ELIAS HOMME Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate student, 1902-1903. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. HOWELL Santa Fe, New Mexico.

Student, 1900-1905. From Socorro, New Mexico. Civil engineer on railway from Acapulco, Mexico, 1906-1907; Civil engineer, Mexican Central R. R., 1907-1912; Assistant to state engineer, Santa Fe, New Mexico, 1913—.

HARRY J. HUBBARD Rosario, Sinaloa, Mexico.

(B. S., New Mexico School of Mines, 1906.)

Student, 1905-1906. From Bisbee, Arizona. Mine foreman, Navidad Mine of Greene Gold-Silver Company, Concheno, Chihuahua, Mexico, 1906; Chemist, same company, 1906; Assistant mill superintendent, Sahuanycan Mining Company, Sahuanycan, Chihuahua, Mexico, 1906; Machine drill foreman, Sirena Mine, Guanajuato, Mexico, 1907; Shift boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan and associates in southwestern states of Mexico, 1907; Tramway superintendent, Bonanza Mine, Zacatecas, Mexico, 1908; Foreman, Butters Divisavero Mines, Jocoro, San Salvador, Central America, 1909-1910; Superintendent, Las Animas Mining Company, Hermosilla, Sonora, Mexico, 1910; Foreman, Minas del Tajo, Rosario, Sinaloa, Mexico, 1911—.

JOHN AUGUST HUNTER Denver, Colorado.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro, New Mexico. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-1904; Chemist and metallurgist, American Smelting and Refining Company, Aguascalientes, Mexico, 1904-1908; Metallurgist, Congress Mining Company, Congress, Arizona, 1909-1910; Assayer, Los Angeles, California, 1910-1911; Engineer, Pioneer Mining Company, Tucson, Arizona, 1911-1912; Engineer, American Zinc Ore Separator Company, Denver, Colorado, 1912—.

FRANK A. JOHNSTON

Entered, 1911, from New Bloomfield, Pennsylvania. Candidate for B. S., degree in Civil Engineering.

JOSEPH POWELL LILES

Entered, 1910, from Socorro, New Mexico. Academic department.

CHARLES THAYER LINCOLN New York, New York.

(B. S., Machasusetts Institute of Technology, 1901.)

Graduate student, 1902-1903. From Boston, Massachusetts. Chemist, Bell Telephone Company, 1901-1902; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-1903; Acting professor, same, 1903-1904; Instructor in Chemistry, Iowa State University, Iowa City, Iowa, 1904-1905; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-1907; Chemist, Arbuckle Brothers Sugar Refinery, Brooklyn, New York, 1907-1909; Chemist, United States Custom Service, New York, New York, 1910—.

FRANCIS CHURCH LINCOLN New York, New York.

(B. S., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1902.)

Assayer, San Bernardino Mining Company, 1900; Chemist, Butterfly Terrible Gold Mining Company, 1900-1901; Professor of Metallurgy, New Mexico School of Mines, 1902-1904; Assistant superintendent, Ruby Gold & Copper Company, Ortiz, Sonora, Mexico, 1904; General manager, Arizona Gold & Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907-1910; Mining engineer, New York, New York, 1911—.

IRENE GRACE LAFFONT

Entered, 1912, from Socorro, New Mexico. Academic department.

RAFAEL LOPEZ

Entered, 1912, from Socorro, New Mexico. Academic department.

HORACE T. LYONS

Entered, 1908, from El Paso, Texas. Candidate for B. S. degree in Mining Engineering.

HARRY C. MAGOON Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer, Illinois Steel Company, Chicago, Illinois, 1911.

FRANK MALOIT

Entered, 1911, from Elmhurst, Illinois. Junior class..

LLOYD L. MAYER

Entered, 1912, from Socorro, New Mexico. Academic department.

CONRAD C. MEYER New York, New York.

(A. B. New York University; M. D. Bellevue Hospital.)

Graduate student, 1900-1901. From New York, New York.

DANIEL M. MILLER Lake Valley, New Mexico.

(B. S., New Mexico School of Mines, 1909.)

Student, 1906-1909. From Lake Valley, New Mexico.

TARVER MONTGONERY Santa Ana, California.

Student, 1899-1900. From Santa Ana, California. County surveyor, Orange county, California, 1990-1901; Assistant engineer, Temescal Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles & Salt Lake Railroad Company, 1901-1902; Assistant engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

EARLE GIBBON MORGAN Guadalajara, Jalisco, Mexico.

(E. M., New Mexico School of Mines, 1911.)

Student, 1907-1908, 1910-1911. From Lansdowne, Pennsylvania. Pennsylvania State College, 1908-1910. Engineer, Socorro Mines Company, Mogollon, New Mexico, 1911-1912; Assistant engineer, same company, Guadalajara, Jalisco, Mexico, 1912—.

ERLE D. MORTON Los Angeles, California.

(E. M. in Mining Geology, New Mexico School of Mines, 1909.)

Student, 1903-1905, 1908-1909. From Los Angeles, California. Assistant superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-1906; Washington University, 1906-1907; Mine examiner, Los Angeles, California, 1907-1908; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908; Mine superintendent, Arizona & Nevada Copper Company, Luning, Nevada, 1909-1910; Mining engineer, Los Angeles, California, 1910; Chief engineer, Lone Mountain Tunnel Company, Superior, Montana, 1911-1912; with Braun Corporation, Los Angeles, California, 1912—.

WILLIAM FREDERICK MURRAY Delagua, Colorado.

Student, 1904-1906. From Raton, New Mexico. In chief engineer's office, Victor Fuel Company, Denver, 1906-1907; Assistant engineer, Victor Fuel Company, 1907-1908; Assistant to chief and traveling engineer, Victor Fuel Company and Colorado & Southwestern Railway Company, 1908; Assistant engineer, Hastings Mine, Victor Fuel Company, Hastings, Colorado, 1909-1910; Superintendent, Cass mine, Victor American Fuel Company, Delagua, Colorado, 1910—.

LLOYD A. NELSON

Entered, 1911, from Santa Rita, New Mexico. Freshman class.

CLYDE M. NEY

Entered, 1912, from Madisonville, Louisiana. Academic department.

ANTHONY FRANCIS O'BOYLE

Entered, 1912, from Rice, Arizona. Freshman Class.

MARTIN J. O'BOYLE

Entered, 1910, from Rice, Arizona. Junior class.

PATRICK J. O'CARROLL*

(A. B., University of Dublin, Ireland.)

Graduate student, 1898-1899. From Dublin, Ireland. Mine operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN*

(B. S., New Mexico School of Mines, 1896.)

Student, 1895-1896. From Butte, Montana. Assistant superintendent, Philadelphia Mines, Butte, Montana, 1896-1897.

JUAN PALISSO Mexico.

Student, 1903-1904. From Barcelona, Spain. Mining engineer, Mexico.

ORESTE PERAGALLO Tepec, Mexico.

(E. M., New Mexico School of Mines, 1908.)

Student, 1907-1908. From Ciudad Juarez, Chihuahua, Mexico. Mining engineer, El Paso, Texas, 1908-1910; Graduate student, New Mexico School of Mines, 1910-1911; Mining engineer, El Paso, Texas, 1911-1912. Chemist, Tepec, Mexico, 1912—.

FOUNT RAY Italy, Texas.

Student, 1901-1902. From Waxahachie, Texas. General manager, Lena Mining & Concentrating Company, Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902.

ALBERT BRONSON RICHMOND Tucson, Arizona.

Student, 1900-1901. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gabilan, Sonora, Mexico, 1901-1902; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and metallurgist, Patagonia, Arizona; General manager, Mansfield Mining & Smelting Company, Patagonia, Arizona, 1908; Consulting engineer, Tucson, Arizona, 1909; Field engineer, Mines Company of America with headquarters at Tucson, Arizona, 1910—.

DELL FRANK RIDDELL Parral, Chihuahua, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; E. M., New Mexico School of Mines, 1905.)

Graduate student, 1903-1905. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, Sioux Falls, South

*Deceased.

Dakota, 1901-1903; Instructor in Chemistry, New Mexico School of Mines, 1903-1904; Acting professor of assaying, same, 1904-1905; Holder of Allis-Chalmers Scholarship, 1905-1906; Engineer, Universam Pump & Manufacturing Company, Kansas City, Missouri, 1906-1907; Superintendent, Benito Juarez Mine, Parral, Chihuahua, Mexico, 1907-1908; Consulting engineer and acting superintendent, Providentia Mines Company, Parral, Chihuahua, Mexico, 1908.

SOREN RINGLUND

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1910-1912. From Ceresco, Nebraska.

ORLANDO DOUGLAS ROBBINS — Depue, Illinois.

(B. S. and E. M., New Mexico School of Mines, 1909.)

Student, 1905-1909. From Louisville, Kentucky. Chemist, El Chino Copper Company, Santa Rita, New Mexico, 1909-1910: Mill superintendent, Germania Mining Company, Springdale, Washington, 1910; Chief sampler, Inspiration Copper Company, Globe, Arizona, 1910; Engineer, United States Steel Company, Depue, Illinois, 1911—.

JULIUS SANCHEZ

Entered, 1912, from Socorro, New Mexico. Freshman class.

CHARLES L. SEARCY — Monterey, Nuevo Leon, Mexico.

Student, 1903-1904. From Peoria, Illinois. Mining engineer, Monterey, Nuevo Leon, Mexico.

CHARLES S. SHAMEL — Seattle, Washington.

(B. S., M. S., University of Illinois; LL. B. University of Michigan; A. M., Ph. D., Columbia University.)

Graduate student, 1901-1902. Mining Lawyer, Seattle, Washington.

E. B. SMILEY

Entered, 1912, from Socorro, New Mexico. Special.

JAMES AVERY SMITH

Entered, 1908, from Socorro, New Mexico. Candidate for B. S. degree in Metallurgical Engineering, 1913.

OLIVER RUSSELL SMITH — Naches, Washington.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1908; C. E., New Mexico School of Mines, 1903.)

Graduate student, 1898-1901. From Manhattan, Kansas. B. S. in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1901; Instructor in Engineering and Drawing, same, 1901-1902;

Assistant professor in Engineering and Drawing, same, 1902-1903; Assistant surveyor, U. S. General Land Office, 1902; City engineer, Socorro, New Mexico, 1902; Deputy mineral surveyor, U. S. General Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1903-1907; Civil engineer, Santa Fe Railway, San Barnadino, California, 1907-1908; Engineer, United States Reclamation Services, Zillah, Washington, 1908-1910.

JACOB STAPLETON

Entered, 1912, from Socorro, New Mexico. Academic department.

PAUL E. M. STEIN El Paso, Texas.

(B. S., New Mexico School of Mines, 1911; E. M. in Mining Geology, 1912.)

Student, 1907-1912. From Davenport, Iowa. Assistant engineer, Socorro Mines Company, Mogollon, New Mexico, 1912; Chemist, El Paso Plant, Kansas City Consolidated Smelting and Mining Company, El Paso, Texas, 1912—.

WILLIAM CARLOS STEVENSON*

Student, 1900-1901. From Hillsboro, Ohio. General manager, Mining Corporation, Albuquerque, New Mexico, 1901.

KARL AKSEL STRAND Bisbee, Arizona.

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1906-1912. From Socorro, New Mexico. Ore classifier, Utah Copper Company, Garfield, Utah, 1912; Draughtsman, same, 1912.

JOHN STUPPE Torreon, Coahuila, Mexico.

Student, 1903-1904. From El Paso, Texas. Accounting department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical department, Compania Metalurgicá de Torreon, Torreon, Coahuila, Mexico, 1904.

LEO RICHARD AUGUST SUPPAN St. Louis, Missouri.

(B. S. in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)

Student, 1895-1896. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-1897; Graduate student, John Hopkins University, Baltimore, Maryland, 1897-1898; Professor of Chemistry, Marine-Sims College, St. Louis, Missouri, 1898—.

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*Deceased.

OTTO JOSEPH TUSCHKA Monterey, Nuevo Leon, Mexico.

(E. M. in Metallurgical Engineering, New Mexico School of Mines, 1897.)

Student, 1893-1897. From Socorro, New Mexico. Assayer and chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-1898; Graduate student, New Mexico School of Mines, 1898-1899; Assistant sampling mill foreman and chemist, Guggenheim Smelting & Refining Company, Monterey and Aguascalientes, Mexico, 1899-1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chief chemist, Compania Minera, Fundidora, y Afinadora "Monterey," Monterey, Nuevo Leon, Mexico, 1900—.

LAURENCE P. WELD Amodor City, California.

(B. S. and E. M., New Mexico School of Mines, 1912.)

Student, 1908-1912. From Rochester, New York. Concentrator man, Original Amador Mines Company, Amador City, California, 1912—.

MILTON BENHAM WESCOTT Monterey, Nuevo Leon, Mexico.

Student, 1904-1905. From Chicago, Illinois. Engineering corps, Santa Fe Railway, 1905; Assistant county surveyor, El Paso county, Texas, 1906-1907; Assistant engineer, Monterey Railway, Light and Power Company, Monterey, Nuevo Leon, Mexico, 1907; Assistant engineer, Monterey Water-works and Sewer Company, Monterey, Nuevo Leon, Mexico, 1907-1908; Resident engineer, same, 1908.

PATRICK ANDREW WICKHAM Maris, Chihuahua, Mexico.

Student, 1893-1894. From Socorro, New Mexico. Mechanical engineer, Buckeye Mining Company and Albemarle Mining Company, Bland, New Mexico, 1898-1899; Mechanical engineer, Mt. Beauty Mining Company, Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Company, Cripple Creek, Colorado, 1900-1901; Foreman, Guggenheim Exploration Company, Minas Tecolotes, Santa Barbara, Chihuahua, Mexico, 1901-1902; Foreman, Independence Consolidated Gold Mining Company, Cripple Creek, Colorado, 1902-1904; Manager, Consuelo & Esperanza Gold Mining Companies, Dolores, Mexico, 1904-1906; Assistant superintendent, Kelvin-Calumet Copper Mining Company, Ray Arizona, 1907-1908; Superintendent La Cienega Mining Company, Maris, Chihuahua, Mexico, 1909—.

WAKELEY A. WILLIAMS Grand Forks, British Columbia, Canada.

Student, 1893-1894. From Council Bluffs, Iowa. Assistant superintendent, Granby Consolidated Mining, Smelting, and Power Company, Limited, Grand Forks, British Columbia, Canada, 1898. At present, superintendent of same.

INDEX.

ANNUAL REGISTER

OF THE

NEW MEXICO STATE SCHOOL OF MINES

SOCORRO, N. M.

1913-1914

WITH ANNOUNCEMENTS FOR 1914-1915

MAIN BUILDING

ANNUAL REGISTER

OF THE

NEW MEXICO
STATE
SCHOOL OF MINES

SOCORRO, N. M.

1913-1914

WITH ANNOUNCEMENTS FOR 1914-1915

UNION LABEL
ALBRIGHT & ANDERSON,
PRINTERS-BINDERS,
ALBUQUERQUE

CALENDAR.

1914.

First Semester:

September 21, Monday—Registration of students.
September 22, Tuesday—Class work begins.
November 26, Thursday—Thanksgiving.
December 23, Wednesday, 4 P. M.—Holiday recess begins.

1915.

January 4, Monday—Work resumed.
January 25, 26, 27—Examinations.

Second Semester:

January 28, Thursday—Second semester begins.
May 24, 25, 26—Final examinations.
May 27, Thursday, 8:30 P. M.—Commencement.

BOARD OF REGENTS.

HIS EXCELLENCY, WILLIAM C. MCDONALD, *Governor of New Mexico, ex-officio*........................Santa Fe

HON. ALVAN N. WHITE, *Superintendent of Public Instruction, ex-officio*............................Santa Fe

A. C. TORRES..................................Socorro

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W. M. BORROWDALE...........................Magdalena

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CAPT. M. COONEY.............................Socorro

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CAPT. M. COONEY....................Secretary and Treasurer

MRS. BLANCHE E. REED.......................Clerk of Board

FACULTY.

Fayette Alexander Jones........................*President*

C. E., E. M., State School of Mines, University of Missouri, 1892; Engineer, Union Mining Company, Phoenix, Arizona, 1893; Topographic Engineer for sewer system, Indepnedence, Mo., 1894; Chief of topographic surveys, Isthmus of Tehuantepec, 1894-5; Mining Engineer, Phoenix, Ariz., 1896; U. S. Assayer at Kansas City, 1896-8; Chemist of Missouri State Geological Survey, 1897-8; President New Mexico School of Mines, 1898-02; LL. D., Nashville College of Law, Tenn., 1903; Field Assistant U. S. Geological Survey, 1901-6; Member New Mexico Board of Exposition Managers to International Exposition at St. Louis and chairman of Committee on Mines and Mining, 1903-4; Statistician of U. S. mint for precious metals of New Mexico, 1904-6; Geologist, Colorado, Columbus & Mexican Railway, 1908-9; Chief of expedition and mineralogist to Island Tiburon in Gulf of California, 1909; Mining Engineer, Grants Pass, Oregon, 1910-11; Chief of geological and mineralogical explorations through central British Columbia along proposed line of Grand Trunk Pacific Railway, 1911-12; re-elected President New Mexico State School of Mines, 1913—; Author, etc.

Thomas Calvin MacKay.....*Professor of Physics, Mathematics*

A. B., Dalhousie University, 1893; Principal of Baddeck Academy, 1893-94; Principal of Parrsboro High School, 1894-96; Graduate student at Dalhousie University, 1896-98; A. M. at Dalhousie, 1898; A. M. at Harvard, 1899; Assistant in Physics at Harvard University, 1899-1900; Austin Teaching Fellow at Harvard, 1900-1901; Assistant at Harvard and Radcliffe, 1901-04; Ph. D. at Harvard, 1903; Instructor in Physicas at the University of California, 1904-09; Demonstrator in Physics at Dalhousie University, 1909-10; Professor of Physics at Mt. Allison University, 1910-11; Professor of Physics and Mathematics at the New Mexico State School of Mines, 1911—; Author of a text-book on physical measurements and of various papers on physical subjects.

Gustavus Edwin Anderson........................
......................*Professor of Geology and Mineralogy*

S. B. in Geology, University of Chicago, 1905; A. M., Columbia University, 1906; Instructor in Geology, Columbia University, 1905-06; University Fellow in Geology, Columbia University, 1906-07; Professor of Geology, Imperial Mining College, Wuchang, China, 1907-09; Geologist for the Han Yang Iron Works, Han Yang, China, 1908-09; Associate Professor of Geology, Pennsylvania State College, 1909-1911; in charge of field work on the Belle Fonte Quadrangle, State College, Pa., 1908-09; Professor of Geology and Mineralogy, New Mexico State School of Mines since 1911.

Viggo E. Hanson..............*Professor of Civil Enginnering*

B. S., State University of South Dakota, 1910; on erecting floor, Blake Knowles Pump Works, East Cambridge, Mass., 1910-11; Draftsman, Blake Knowles Pump Works, East Cambridge, Mass., 1911-12; Assistant Professor of Civil Engineering, New Mexico State School of Mines, 1912-14; Professor of Civil and Mechanical Engineering, New Mexico State School of Mines, 1914—.

ELTON L. QUINN........................*Professor of Chemistry*

A. B., Bates College, Lewiston, Maine, 1910; Assistant instructor in chemistry, Princeton University, 1910-12; Junior chemist, U. S. Bureau of Mines, Pittsburgh, Pa., summer of 1912; Graduate Fellow, Princeton University, 1912-13, with Ph. D.; Research chemist on naval stores by-products, for the Bagdad Land and Lumber Company, Bagdad, Florida, 1913-14; Head of Department of Chemistry, New Mexico State School of Mines, 1914—.

HOWARD STRIEF......................................

.......*Professor of Mining and Metallurgical Engineering*

B. S. graduate in Mining Engineering, Case School of Applied Science, Cleveland, Ohio, 1903; Draughtsman, East Ohio Gas Company, 1904; aided in construction of and worked in cyanide mill, Deadwood, S. D., 1905; Teacher in Mechanical Drawing, Central Manual Training School, five years; between 1910-14 was engaged in various mining, metallurgical and engineering work for the Guggenheims and others, namely at Velardena, Durango, and Santa Eulalia, Chihuahua, Mexico; in charge of the interests of the City of Cleveland, Ohio, during construction of the Cleveland Short Line Railway; did the field engineering for the construction of blast furnace plant, embracing practice in re-inforced concrete, cable tramways and in conducting a general engineering business for the past two years in Cleveland, Ohio, Professor of Mining and Metallurgical Engineering, New Mexico State School of Mines, 1914—.

J. B. GUNTER................*Principal Academic Department*

B. Pd., New Mexico Normal School at Silver City, 1911; Principal of Public School, San Marcial, N. M., 1911-1912; Instructor in New Mexico Normal School (summer sessions) 1911 and 1913; M. Pd., New Mexico Normal at Silver City, 1913; Superintendent of Public Schools at Belen, N. M., 1912-1914; Principal Academic Department, New Mexico State School of Mines, 1914—.

MRS. BLANCHE E. REED..............*Registrar and Librarian*

NEW MEXICO STATE SCHOOL OF MINES

HISTORICAL SKETCH.

The New Mexico State School of Mines was founded by Act of the Legislature of 1889. The Act provided for the support of the School by an annual tax of one-fifth of a mill on all taxable property.

Under an Act of the Legislature, approved February 28, 1891, a board of trustees was appointed. Organization was effected and immediate steps were taken towards the erection of necessary buildings. In the same year a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892 a circular of information regarding the New Mexico School of Mines at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made to enable the School of Mines to be organized in accordance with the policy outlined by the Act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land fifty thousand acres for its support and maintenance. From this source of revenue the School has already received more than $17,000.

In 1899 the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901 the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grants of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903 the Thirty-fifth General Assembly raised the millage

to forty-five one-hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

Since 1903 the appropriation for the support and maintenance of the School of Mines has been increased at each session of the General Assembly. At the first session of the State Legislature the appropriation was raised to $22,500 a year.

By the terms of the Enabling Act under which New Mexico was admitted to statehood, the School of Mines becomes possessed of 150,000 acres of land. Most of this land has now been selected and will soon become the source of a very considerable revenue to the institution.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the Act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this Act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agricultural, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this Act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and 10 of this Act. Said trustees and their successors in office shall constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleas-

ure, and of causing all things to be done necessary to carry out the provisions of this Act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said School require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an acurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico State School of Mines is located at Socorro, the county seat of Socorro county, on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the valley of the Rio Grande at the foot of the Socorro range of mountains at an elevation of 4,600 feet above the level of the sea. The surrounding scenery is diversified by plains, valleys, mesas, hills, and mountains. The climate of the locality is pre-eminently pleasant and healthful, and has long attracted health-seekers who would escape the rigors of less favored localities. The air is exceedingly dry and the temperature is mild and equitable. Socorro's public water supply comes from warm springs that issue from Socorro mountain three miles away. The water is famed for its purity and has always been an attraction to visitors and residents.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying

out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools. Almost the entire geological column is here exposed.

The New Mexico State School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Deming, Fierro, Silver City, Pinos Altos, Santa Rita, Burro mountains, Los Cerrillos, Dawson, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, lixiviation, cyaniding, and other metallurgical processes.

A number of mines of various kinds, smelters, irrigating systems, and other engineering works are accessible to the School. Within a few hours' ride by rail are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the oldest worked lodes in America are in this region. Gold and turquoise were first noted by the conquistadores in 1540-2 by the celebrated expedition of Francisco Vasquez Coronado, when in search of the Gran Quivira, one of the seven cities of Cibola. The first modern discovery of gold in New Mexico was made at the base of the Ortiz mountains, in Santa Fe county, in the year 1828. The first copper mined west of the Mississippi river was at Santa Rita in Grant county, in 1800. The metal from these copper mines was transported on the backs of burros to Mexico City and thence sent to the royal mint of Spain to be made into coin. The Chino Copper Company now operate these celebrated mines. Among the great wonders of the West are the ancient turquoise working at Mount Chalchihuitl near Los Cerrillos. An ancient lode mine, known as Mina del Tierra, is situated near the ancient turquoise workings. Verily, New Mexico is the birth place of American mining.

The history of modern mining schools shows that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico State School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of the world.

The School is a state institution. It was established primarily to promote the development of the mineral resources of New Mexico and to provide facilities for the young men of the state to secure a practical education in all departments of mining. Naturally, however, the institution's field of usefulness has steadily grown broader. Not only New Mexico but also other parts of the southwest have felt its influence through its graduates in the development of the mining industries of this great region. Moreover, a considerable number of students from other parts of the country who desired to avail themselves of the peculiar advantages of this region have come to the School of Mines for the training they needed and the number of such young men is constantly increasing.

During the entire period of his training the fact is impressed upon the mind of the student that intelligent mining is a business operation capable of being put on as secure a foundation as any other; that from beginning to end it is akin to all other great business undertakings. While lucky finds will doubtless continue to be made, mining is no longer to be considered a mere lottery appealing to the gambling propensities.

During the past quarter of a century the development of the mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines:

The unique natural surroundings of the School already described create an invigorating mining atmosphere which is entirely wanting in institutions remote from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in those technical institutions of learning where all practical branches are equally represented, singleness of purpose is a leading feature of the New Mexico State School of Mines. The conservation of energy growing out of the special method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect, under the direct supervision of his instructors, various plants and works and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work and at once necessarily acquires for his chosen profession a sympathy that is seldom attained, except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portions, which comprise about two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the state has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made under government auspices to investigate closely the geological struc-

ture of New Mexico mountains such as have been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

Much of the advanced professional work of the School is of an original nature to the end that the graduates may be skilled, theoretically and practically, in the very problems which they as professional men will be called upon to solve. This work is carried on by the advanced students under the direction of the professors and involves the collection of notes, sketches, maps, and specimens, and the results of directed observations in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining and in the reduction of the ores of lead, silver, gold, copper, and zinc are so numerous that it is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply, and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, thus giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigators of the ores of iron, manganese, aluminum, cobalt, nickel, tin, and quicksilver, vanadium, and uranium, together with the beds of coal, salt, alum, building stones, mineral-paints, cement-rocks, marls, etc., are directly in line with the advanced laboratory work of the School, and every student who undertakes such work is encouraged in every possible way to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico State School of Mines is vested in a Board of Regents consisting of five members appointed by the Governor of the State with the concurrence of the Senate for a term of four years. The Board of Regents elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them, as well as the selecting of a teaching staff.

By Act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of the state. The New Mexico State School of Mines, therefore, is composed of the College and the Academy.

THE COLLEGE.

Requirements for Admission.

Candidates for admission to the College are required to present a statement from some school of recognized standing certifying that they have completed and received a passing grade in the following subjects: Arithmetic, Elementary Algebra, Plane and Solid Geometry, ninth and tenth grade English, and one year of Elementary Physics. Those candidates who are unable to present such a statement may take an examination by the Principal of the Academy on any of the foregoing subjects to determine their proficiency therein.

Registration.

No student will be allowed to register for any subject until the pre-requisites are credited to him on the school records. Therefore the student is advised not to delay either in making up any deficiencies which may exist or in obtaining from the School the credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the Bachelor's Degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time of matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be

required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the School may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students desiring to take special courses without a view to graduation may do so provided that they give evidence of proficiency in the prerequisite subjects and that their taking such courses does not interfere with the regular schedule of classes.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

Curricula.

MINING ENGINEERING.
METALLURGICAL ENGINEERING.
GEOLOGICAL ENGINEERING.
CIVIL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of either of them the Bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines who have spent two years in professional work, at least one of which must have been in a position of responsibility, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours' work in the field or in the laboratory. In the following outlined statement of curricula the number of hours per week required in the class-room and in the field or in the laboratory are given separately. The number of hours required in the field or in the laboratory represents *average* time, however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

Short Courses.

For the benefit of resident young men of the state short courses of a few weeks' duration will be given in prospecting, assaying, mineralogy, surveying, chemistry, mechanics, electricity, etc. Such a departure from the full college courses ought appeal to those who wish to attain greater efficiency, which will mean a corresponding increase in wages.

UNIFORM CURRICULUM FOR THE FIRST YEAR.

The curriculum for the first year of the four courses offered at the School of mines is the same in all respects. This arrangement is of advantage to the student, for it gives him until the beginning of the second year to determine for which of the four courses he is best fitted by inclination or aptitude.

Mathematics, physics, and chemistry are fundamental subjects for the successful engineer. For that reason the first year of all the engineering courses is devoted to a thorough grounding in those three subjects, as will be seen in the tabular statement below. Specialization does not begin until afterwards.

Excellent facilities are offered for the acquisition of a thorough knowledge of these subjects so necessary to successful engineering work both during the remainder of the course and during a professional career.

FIRST YEAR.

Course Numbers	Courses.	Hours per Week	
		Class.	Lab'y
	First Semester.		
I. 1.	Algebra	5	
I. 2.	Trigonometry (Plane)	5	
I. 3.	Analytic Geometry	2	
III. 1.	General Chemistry	3	6
IV. 16.	Shop		3
IV. 18.	Mechanical Drawing		9
	Second Semester.		
I. 1.	Advanced Algebra	3	
I. 2.	Trigonometry (Spherical)	1	
I. 3.	Analytic Geometry	4	
III. 2.	Qualitative Analysis	1	9
III. 2a.	(For Civil Engineers)	1	6
IV. 1.	General Surveying	3	4
IV. 16-17.	Shop		3
IV. 19.	Machine Drawing		6
IV. 21.	Descriptive Geometry	2	

MINING ENGINEERING.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valuing property, properly reporting propositions submitted for investment, calculating the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaptation of the steam shovel and stripping methods to western metal mines are treated at considerable length.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives detailed consideration.

FIRST YEAR.

See Page 17.

SECOND YEAR.

Course Numbers		Courses.	Hours per Week	
			Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	3.	Quantitative Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	5.	Ore Analysis	1	9
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers		Courses.	Hours per Week Class.	Hours per Week Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	6.	Fuel Analysis		3
V.	4.	Field Geology		8
V.	7.	Petrology	2	3
VI.	1.	Mining A	3	3
VII.	2.	General Metallurgy	3	2
IV.	22.	Steam Engines and Boilers	5	
		Second Semester.		
II.	4.	Mechanics	4	
IV.	6.	Strength of Materials	5	
V.	7.	Petrology	2	3
VI.	2.	Mining B	3	
VII.	1.	Fire Assaying	1	8
IV.	20.	Machine Design	2	6

FOURTH YEAR.

Course Numbers		Courses.	Hours per Week Class.	Hours per Week Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism	3	3
IV.	15.	Mine Constructions	3	9
V.	5.	Economic Geology	3	
V.	4.	Mine Econmics	3	
V.	6.	Ore Dressing	3	
VI.	9.	Design of Mine Plant		3
VII.	5.	Metallurgy of Copper	2	
IV.	23.	Hydraulics	3	
		Second Semester.		
IV.	15.	Mine Constructions	3	9
V.	5.	Economic Geology	3	
IV.	24.	Air Compression and Pumping	3	
VI.	6.	Ore Dressing	2	
VI.	9.	Design of Mine Plant		6
VI.	7.	Mine Administration and Accounts	2	
VI.	8.	Examination of Mines	1	3

METALLURGICAL ENGINEERING.

The aim of this four years course is to train the student for a professional career in any branch of metallurgical work. Attention is given during the first two years to such fundamental subjects as mathematics, chemistry, physics, geology, mineralogy and preliminary courses in engineering. Instruction in metallurgy proper begins in the third year, both lectures and laboratory experiments being employed for the purpose. Chemistry and geology are provided for, also. The work of the fourth year is along the line of advanced courses in metallurgy; special attention being given to laboratory experiments, high temperature conditions of metallurgy, training in execution, and interpretation of results. Such higher branches of engineering, chemistry, and courses of importance in mining engineering claim a considerable share of attention.

The course has been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals.

FIRST YEAR.

See Page 17.

SECOND YEAR.

Course Numbers		Courses.	Hours per Week	
			Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	3.	Quantitative Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	5.	Ore Analysis	1	9
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers		Courses.	Hours per Week Class.	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	6.	Fuel Analysis		3
III.	9.	Electro-Analysis	1	6
V.	5.	Economic Geology	3	
V.	3.	Elements of Mining	3	3
VII.	3.	Principles of Metallurgy	3	2
IV.	22.	Steam Engines and Boilers	5	
		Second Semester.		
II.	4.	Mechanics	4	
IV.	6.	Strength of Materials	5	
V.	6.	Economic Geology	3	
VII.	1.	Fire Assaying	1	8
VII.	7.	Metallurgy of Iron and Steel	3	
IV.	20.	Machine Design	2	6

FOURTH YEAR.

Course Numbers		Courses.	Hours per Week Class.	Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism	3	3
IV.	16.	Mine Constructions	3	9
VI.	6.	Ore Dressing	3	
VII.	6.	Metallurgy of Gold and Silver	3	
VII.	5.	Metallurgy of Copper	2	
VII.	9.	Metallurgical Plant and Design	1	3
IV.	23.	Hydraulics	3	
		Second Semester.		
IV.	15.	Mine Constructions	3	9
VI.	6.	Ore Dressing	2	
VI.	7.	Mine Administration and Accounts	2	
VII.	4.	Metallurgy of Lead	3	
VII.	8.	Furnaces	3	
VII.	9.	Metallurgical Design		6
VII.	10.	Metallurgical Laboratory	1	8

GEOLOGICAL ENGINEERING.

This course extending over a period of four years is intended primarily to train men to examine, report and direct the future development of mines. In the first two years the course prescribed is similar to that of the Mining Engineering Department, so that students have a thorough training in fundamental subjects, especially in mathematics, chemistry, surveying, and other preliminary courses in engineering. In the third year the attention of the student is directed largely to geological subjects related closely to mining, namely, topographical surveying, geological surveying, petrology, and economic geology, while still continuing his studies in chemistry, mining, metallurgy, etc. The fourth year is devoted largely to advanced work in mining geology, visiting and reporting in detail on geological problems connected with ore deposition in various mining fields. Attention also is paid to the geological occurrence of peroleum.

FIRST YEAR.

See Page 17.

SECOND YEAR.

Course Numbers		Courses.	Hours per Week Class.	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	3.	Quantitative Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	5.	Ore Analysis	1	9
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	

THIRD YEAR.

Course Numbers		Courses.	Hours per Week Class.	Hours per Week Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	6.	Fuel Analysis		3
III.	8.	Advanced Quantitative Analysis	1	6
V.	4.	Field Geology		8
V.	5.	Petrology	2	6
VI.	1.	Mining A	3	3
VII.	2.	General Metallurgy	3	2
		Second Semester.		
II.	4.	Mechanics	4	
III.	8.	Advanced Quantitative Analysis		6
V.	6.	Economic Geology	3	3
VI.	2.	Mining B	3	
VII.	1.	Assaying	1	8

FOURTH YEAR.

Course Numbers		Courses.	Hours per Week Class.	Hours per Week Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism	3	3
III.	10.	Physical Chemistry	2	
V.	7.	Economic Geology	3	3
V.	9.	Ore Genesis		6
VI.	4.	Mine Economics	3	
VI.	6.	Ore Dressing	3	
VI.	9.	Design of Mine Plant		3
IV.	23.	Hydraulics	3	
		Second Semester.		
V.	7.	Petrology	2	6
V.	8.	Geological Examination and Surveys	2	
V.	10.	Paleontology	2	6
V.	11.	Special Problems		5
IV.	24.	Air Compression and Pumping	3	
VI.	7.	Mine Administration and Accounts	2	
VI.	8.	Examination of Mines	1	3
VI.	9.	Design of Mine Plant		6

CIVIL ENGINEERING.

This department provides a course of study in the theory and application of the principles of civil engineering. The first two years of work are substantially the same as in the other engineering courses, including practical work in drafting room and field, as well as instruction in the fundamental principles of mathematics and physics. In the third year the studies relate more directly to civil engineering. Technical courses cover the principles of structural and machine design, power and power transmission, and other fundamental engineering processes. In the drafting room the student applies those principles to the design of machines, and bridge and roof trusses. Sufficient field work is given to make the student thoroughly familiar with surveying instruments, and their use in road, mine, and railroad surveys.

FIRST YEAR.

See Page 17.

SECOND YEAR.

Course Numbers		Courses.	Hours per Week	
			Class.	Lab'y
		First Semester.		
I.	4	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	4.	Engineering Analysis	1	6
IV.	2.	Mine and Railroad Surveying	4	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	3
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
IV.	3.	Topographical Surveying	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	
VII.	7.	Iron and Steel	3	

THIRD YEAR.

Course Numbers		Courses.	Hours per Week Class.	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
IV.	4.	Railway Location	3	4
IV.	5.	Roads and Pavements	3	
V.	5.	Economic Geology	3	
IV.	22.	Steam Engines and Boilers	5	
		Second Semester.		
II.	4.	Mechanics	4	
III.	8.	Advanced Quantitative Analysis		6
IV.	6.	Strength of Materials	5	
IV.	7.	Graphics	2	
V.	6.	Economic Geology	3	
IV.	20.	Machine Design	2	6

FOURTH YEAR.

Course Numbers		Courses.	Hours per Week Class.	Lab'y
		First Semester.		
II.	3.	Electricity and Magnetism	3	3
III.	6, 7.	Water and Fuel Analysis		6
IV.	9.	Stresses	3	
IV.	10.	Structural Details		9
IV.	11.	Water Supply Engineering	5	
IV.	12.	Masonry	5	
IV.	23.	Hydraulics	3	
		Second Semester.		
IV.	8.	Railroad Track, Yards, Structures	3	
IV.	9.	Stresses	3	
IV.	10.	Structural Details		9
IV.	13.	Sewerage and Drainage	5	
IV.	14.	Concrete Structures	3	
IV.	25.	Contracts and Specifications	2	

DEPARTMENTS OF INSTRUCTION

I. DEPARTMENT OF MATHEMATICS.

DOCTOR MACKAY.

The study of mathematics is emphasized as a necessary basis for the further instruction in the engineering subjects. The courses have been arranged to meet the extensive needs of students in the various branches of engineering and are intended to develop power of deduction as well as to familiarize the student with the various methods of calculation used in practical problems. Students are encouraged to use logarithms and the slide rule when the latter can be employed without too great loss of accuracy. They will also be introduced to the books of tables that facilitate calculation.

1. Advanced Algebra.

The work begins with a review of elementary algebra. This is followed by the solution of simple and quadratic equations with a large number of practical problems, the summation of arithmetical and geometrical progressions, graphical solutions of equations, vector quantities, variation and proportion, partial fractions, logarithms, inequalities, probabilities, abridged methods of caluculation, slide rule, and limits of error.

Prerequisite: *Elementary Algebra.*

Time: Class room, three hours a week, first semester; five hours a week, second semester.

Text: Hawkes, *Advanced Algebra.*

2. Trigonometry.

A thorough knowledge of the subject matter of this course is essential for the successful carrying out of general surveying, topographic surveying, and mine surveying. It deals with the measurement of angles; the relations among the sine, cosine, and tangent of an angle; the values of the functions of multiple and fractional angles; solution of simple trigonometric equations; the solution of right and oblique triangles, involving logarithmic calculations with tables and very many practical prob-

lems; the simplest elements of spherical trigonometry. The last mentioned subject is necessary for an understanding of the methods of determining latitude and longitude, and also is essential for geodetic surveying.

Prerequisites: Elementary Algebra and Plane and Solid Geometry.

Time: Class-room, five hours a week, first semester; one hour a week, second semester.

Text: Murray, *Plane and Spherical Trigonometry with Tables.*

3. Analytic Geometry.

This subject combines the methods used in algebra and in geometry, and employs them in the study of simple curves, surfaces, and solids. It therefore affords a very good introduction to mechanical drawing, mapping, surveying, and mensuration. It deals with plotting with different systems of co-ordinates, estimation of areas, properties of systems of straight lines, circles, the parabola, the ellipse, the hyperbola, changes produced in maps by change of origin and rotation of axes, simple curves in three dimensions, surface areas and volumes of simple solids.

Prerequisites: Courses 1 and 2 of this department must accompany or precede this course.

Time: Class-room, two hours a week, first semester; four hours a week, second semester.

Text: Smith and Gale, *New Analytic Geometry.*

4. Differential Calculus.

This subject is of great importance in the study of curves, of rates of variation, of maximum and minimum values; and is indispensable for the reading of most text-books of science, especially as applied in text-books on engineering. It includes limits, curve tracing and other applications of the derivative, maxima and minima, radii of curvature, summation of series, partial differentiation, solution of many problems on least cost and maximum efficiency.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Time: Class-room, five hours a week, first semester.

Text: Murray, *Differential and Integral Calculus.*

5. Integral Calculus.

The integral calculus is the most powerful weapon of calculation. It is applied in this course to the calculation of lengths of curves, areas of surfaces, volumes of solids, moments of inertia, centers of gravity, work performed by bodies moving against given forces, and many other applications to mechanics, heat, electricity and magnetism, and mensuration.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Time: Class-room, five hours a week, second semester.

Text: Murray, *Differential and integral Calculus.*

SPECIAL AND GRADUATE COURSES IN MATHEMATICS.

Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work. The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in mathematical investigation of problems of engineering or applied science. The idea that an engineer should be a practical rather than a theoretical mathematician has guided the selection of elective and graduate courses. Students who wish to take optional work should arrange at the beginning of the college year with the head of the department of mathematics.

In addition to the foregoing, which are required of all students of engineering, the following elective and graduate courses are offered:

6. Integrals of Mechanics.

Certain types of integrals which are met with great frequency in the study of mechanics, are treated. These integrals, namely, the inertia integrals, those defining mass, and moment and center of mass, are essential in the discussion of the motion and the conditions of equilibrium of systems of particles and rigid bodies. Other integrals are studied, involving applications of mechanics to work, attraction, pressure, and centers of gravity and pressure.

Text: Lester, *The Integrals of Mechanics.*

7. Applications of the Calculus to Mechanics.

Wherever the teaching of mathematics to engineering students is discussed, and frequently in cases of other classes of students,

the criticism which is almost without exception the most insistent is this: that the student leaves the course without adequate ability to *apply* his mathematical knowledge. This means that he has not the faculty of taking a problem, giving it an analytic formulation, and interpreting the analytic results. This course is intended to supply the needed training. Students should obtain a comprehensive view of this course, partly because of the value of such a course as a means of general mental development, partly because new practical applications of discoveries in engineering are continually being made, and because no one can predict what particular facts or principles are most likely to find important practical applications in the future.

Text: Hedrick & Kellog, *Applications of the Calculus to Mechanics.*

8. Differential Equations.

In many Colleges of Engineering, the need is felt for a course treating the subject of Differential Equations, limited in scope, yet comprehensive enough to furnish the student of engineering with sufficint information to enable him to deal intelligently with any differential equation which he is likely to encounter. To meet this need is the object of this course. This course will be found to be complete in all those portions which bear upon practical applications. Numerous applications to problems in Geometry, Physical Sciences, and Engineering are introduced.

Text: Cohen, *An Elementary Treatise on Differential Equations.*

II. DEPARTMENT OF PHYSICS.

DOCTOR MACKAY.

The courses in physics outlined below serve to introduce students to accurate measurements identical with or similar to those which he will have to perform frequently as an engineer. In general, the experiments carried out in these courses help him to understand the physical bases for the varied methods of procedure in engineering proceeses. The apparatus for the course in experimental mechanics is of a very substantial character. This apparatus is well adapted for illustrating principles that lie at the foundation of an engineer's work. As in the other courses in this department, the laboratory work is accompanied by lecture room discussions and by the working out of illustrative problems. The course in heat forms an introduction to metallurgical processes especially. The course in light is introductory to much of the succeeding work in mineralogy and petrography. The elementary course in electricity and magnetism is devised for students of all branches of engineering, especial attention being paid to electrolysis and to the methods of action of simple electrical machines. The student is here introduced to the measurement and caluculation of the principal electrical quantities that are met with in common engineering practice. The succeeding courses in electricity and magnetism are intended to give an opportunity for a deeper study of these subjects, and are intended especially for students who wish to specialize in electrical engineering, or in electrical machinery for mine plants, etc.

1. Experimental Mechanics.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uni-

formly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Expansion of gases; (14) Archimedes' principle; and a few other exercises if time permits.

Prerequisites: Course 2 of Department 1.

Time: Class-room, three hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Millikan, *Mechanics, Molecular Physics and Heat.*
Duff, *Physics.*

2. Heat and Light.

The first part of this course will deal with temperature, expansion, thermal conductivity, radiation, convection, change of state, and calorimetry, with simple applications to furnaces, ventilation, and heat engines. The second part of the course will deal with the laws of reflection and refraction of light, combinations of lenses, eye-pieces and objectives of microscopes, prisms, double refraction, the spectrometer, polarized light and photometry.

Prerequisites: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Text: Duff, *Physics.*
Millikan and Mills, *Light.*
Millikan, *Molecular Physics and Heat.*

3. Electricity and Magnetism.

This course deals with the elementary principles of electricity, magnetism, and the practical application of the same to dynamos, motors, lamps and electric furnaces. Qualitative experiments are performed in the lecture-room to illustrate the principal phenomena of this very large and fruitful subject. Quantitative experiments are performed in the laboratory in order to make the electrical and magnetic quantities as much as possible real quantities in the experience of the student.

Prerequisite: Course 1 of this department must precede or accompany.

Time: Class-room, three hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Duff, *Physics.*
Silvanus Thompson, Elementary Lessons in Electric*ity and Magnetism.*
Millikan and Mills, *Electricity and Magnetism.*

4. Mechanics.

The principal topics taken up are force, combinations of forces, center of gravity, moment of inertia, gravitation, stress, numerous cases of equilibrium, cords, jointed frames, friction, velocity and acceleration, harmonic motion, translation, rotation, work, energy, impulse, momentum, and very many simple practical problems with different forms of structures and machines.

Prerequisites: Courses 2, 3, 4, and 5 of Department I and Course 1 of this department.

Time: Class-room, four hours a week, one year.

Texts: Maurer, *Technical Mechanics.*
Sanborn, *Mechanics Problems.*

5. Electromagnetism.

A discussion of the fundamental equations of electricity and magnetism; and calculation of field intensities, resistances, capacities, self and mutual induction, etc.

Prerequisites: Courses 4 and 5 of Department I and Course 3 of this department.

Time: Class-room, three hours a week, first semester.

Text: Poynting and Thomson, *Electricity and Magnetism.*

6. Alternating Current Measurements.

Measurements of magnetic permeability of various kinds of iron and steel, induction of coils, capacities, efficiency of dynamos and motors, efficiency of transformers, etc. The principal types of alternating dynamos and motors will be studied, as well as the applications of alternating currents to electric lighting and to power transmission.

Prerequisites: Courses 1 and 3 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, six hours a week, second semester.

Text: Pender, *Elements of Electrical Engineering.*

III. DEPARTMENT OF CHEMISTRY.

DOCTOR QUINN.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

1. Elements of Chemistry.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common elements.

The class-room work consists of lectures in which the chemistry of the elements and their compounds is simplified as much as possible. The more important reactions and theories are illustrated with lecture-table experiments and immediately following the class-room work each student performs as many experiments as possible in the laboratory, carefully recording the results. These records are then corrected by the instructor and returned to the student. At the beginning of each class hour, the students are quizzed on both class-room and laboratory work and once each week the work is reviewed in a written test.

Time: Class-room, three hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Kahlenberg, *Outlines of Chemistry.*
Kahlenberg, *Laboratory Exercises in General Chemistry.*

2. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the

laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper group are analyzed. In this matter the metals of all the groups and finally the acids are studied. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze several of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisite: Course 1 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. I.*
Baskerville & Curtman, *Qualitative Analysis.*

2a. Course 2 is given as 2a for Civil Engineers.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, second semester.

3. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

The gravimetric determination of chlorine in a soluble chloride; water of crystallization in copper sulphate; iron and sulphur in ferrous or ferric sulphate; carbon dioxide; calcium, and magnesium in dolomite; silver and copper in a dime; tin, lead, copper, and zinc in a bronze; and silica in an insoluble silicate.

The class-room work consists of lectures and quizzes in which the various analytical processes are studied from the standpoint of modern chemical theories.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. II.*
Fresenius, *Quantitative Chemical Analysis.*

4. Engineering Analysis.

The course includes some of the more important determinations in gravimetric, volumetric, and electro analysis and is planned to give the engineer a general idea of quantitative analysis.

The following are some of the determinations which will be studied: Gravimetric determination of chlorine, iron, alumina, calcium, and magnesium; approximate analysis of coals; analysis of lubricating oils; heat value of coals and oils; volumetric determination of the hardness of water; the per cent purity of soda and lime; the electrolytic determination of silver and copper in a dime; analysis of iron and steel.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Text:

5. Ore Analysis.

A thouroughly practical course in the determining of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products.

Each student is required to analyze two or more ores for each of the following: Iron, copper, zinc, lead, phosphorus, calcium, manganese, silica, sulphur, and arsenic. After this he will be required to accurately complete from ten to thirty determinations for any of the foregoing ores in one half day, thereby gaining a little of the speed and accuracy necessary to every practical assayer.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, second semester.
Labratory, nine hours a week, second semester.

Texts: Low, *Technical Methods of Ore Analysis.*

6. Fuel Analysis.

Analysis of various coals and other fuels are made, their heat values calculated from these analyses and also determined by means of the calorimeter. Flue gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

7. Water Analysis.

Analyses of water are made in regard to their possible use in boilers. These analyses involve determination of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 3 of this department.

Time: Laboratory, last ten weeks of second semester.

Texts: Stilman, *Engineering Chemistry.*
Treadwell & Hall, *Analytical Chemistry, Vol. II.*

8. Advanced Quantitative Analysis.

This course is the extension of Course 3 or 4, and the work will be chosen to suit the needs of each student. It may consist of the complete analysis of rocks and minerals, advanced ore analysis, iron and steel analysis, cement analysis, or the determination of some of the rare elements.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, one semester.

9. Electro-Analysis.

This course will deal with the practical application of the electric current in determining some of the common metals such as copper, silver, lead, and zinc. After the student has become familiar with the methods used for determining each of these, he will use the current in separating mixtures of metals and as a rapid, accurate method of ore analysis.

The course may be substituted for Advanced Quantitative Analysis, Water and Fuel Analysis, or taken as a special.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, one semester.

Text: Edgar F. Smith, *Electro Analysis.*

10. Physical and Theoretical Chemistry.

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry

Prerequisite: Course 3 of this department.

Time: Class-room, two hours a week, first semester.

Texts: Ewell, *Physical Chemistry.*
Jones, *Elements of Physical Chemistry.*

11. Inorganic Preparations. (Special)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 2 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, one semester.

12. Industrial Inorganic Chemistry. (Special)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the de-

tails as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one semester.

Text: Rogers & Aubert, *Industrial Chemistry.*

13. Organic Chemistry. (Special)

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

14. Elements of Practical Photography. (Special)

The course is planned to furnish the engineer with a working knowledge of photography such as will enable him to use the camera intelligently as an aid in his engineering work.

The class-room work will consist of one lecture a week which will be supplemented by laboratory work in which each student will be required to take and finish a good negative, velox print, platinum print, lantern slide, and bromide enlargement.

Time: Class-room, one hour a week, second semester.

IV. DEPARTMENT OF CIVIL ENGINEERING

PROFESSOR HANSON.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the work of the fourth year the student is given instruction in Structural, Sanitary, and Hydraulic Engineering. The work which is largely drawing and design, covers practical problems, with the intent that the student may become thoroughly familiar with the principles governing his profession and with their application.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies.

1. General Surveying.

The introductory course in surveying deals with the principles of land measurement, and with the instruments used in both field and office.

In the class-room, the adjustments of the level and transit are taught, and the uses of these instruments in land surveying illustrated by practical problems.

In the field practice, each student becomes familiar with the use of the chain, tape, level, transit, etc.

Prerequisite: Course 2 of Department I.
Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.
Text: Johnson, *Theory and Practice of Surveying.*

2. Mine and Railroad Surveying.

The work consists of field work, recitations, and drafting room practice.

In the field work, a complete survey of a mining claim is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. In addition a complete survey of the underground excavations is made. Practice is also given in the laying out of railway curves and switches.

In the drafting room maps are made from the notes taken in the field practice. The value of careful work in the field and correct notes is thereby emphasized.

In the class-room, the principles of mining law are taught, and problems dealing with the connection of surface and subterranean workings are solved. The methods of computing and laying out railroad curves are studied.

Prerequisite: Course 1 of this Department.
Time: Class-room, four hours a week, first semester.
Field, four hours a week, first semester.
Texts: Johnson, *Theory and Practice of Surveying.*
Allen, *Railway Curves.*

3. Topographical Surveying.

The theory and use of the stadia and other instruments used in making a topographic survey are considered, as are also the methods of topographic surveying. Some time is given to topographic drawing. A complete topographic survey based on a system of triangulation is executed, including the calculations, and platting and completing the map. Some attention is given to the precise measurement of bases and angles.

Prerequisites: Course 1 of this department.
Time: Class-room, two hours a week, second semester.
Field, four hours a week, second semester.
Text: Johnson, *Theory and Practice of Surveying.*

4. Railway Location.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length.

Prerequisites: Courses 1. 2 and 3 of this department.

Time: Class-room, three hours a week, first semester.
Field, four hours a week, first semester.

Text: Wellington, *Economic Theory of the Location of Railways.*

5. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways; location, construction, drainage, improvement and maintenance of country roads; various paving materials—broken stone, brick, asphalt, wood and stone blocks, and concrete; foundations for and adaptability of each; arrangement and details of city streets.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, first semester.

Text: Baker, *Roads and Pavements.*

6. Strength of Materials.

A study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to torsion, to compression, and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moment, slopes, and deflection; overhanging, fixed, and continuous beams, flat plates, and stresses in columns and in beams subjected to tension and compression as well as bending; torsional stresses; and stresses in spring.

Prerequisite: Course 4 of Department II must accompany or precede.

Time: Class-room, five hours, second semester.

Text: Merriman, *Strength of Materials.*

7. Graphic Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 4 of Department II.

Time: Class-room, two hours a week, second semester.

Text: Merriman and Jacoby, *Roofs and Bridges, Part II.*

8. Railroad Tracks, Yards, and Structures.

Instruction is given in the methods of proper location of railroad yards to insure efficiency of operation. The details of track construction are studied. Each student makes a drawing of some railroad structure, the dimensions being of his own measurement.

Prerequisite: Course 5 of this department.

Time: Class-room, four hours a week, second semester.

Text: Tratman, *Track.*

9. Stresses.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow, and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind, and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisite: Course 6 of this department.

Time: Class-room, two hours a week, one year.

Text: Merriman & Jacoby, *Roofs and Bridges,* Parts I and IV.

10. Structural Details.

Practical applications of the principles of stresses in the de-

sign and proportioning of the various parts of engineering structures. Each student makes a detailed design of a steel roof truss with its supporting columns, a plate girder bridge for railroad traffic, and a highway Pratt truss span.

Prerequisites: Course 6 of this department and Course 9 of this department must accompany.

Time: Laboratory, nine hours a week, one year.

Text: Merriman and Jacoby, *Roofs and Bridges,* Part III

11. Water Supply Engineering.

. The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, method of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, 5 hours, first semester.

12. Masonry.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cement, wood, iron and steel. Special emphasis is placed upon the geological occurrences to the suitable engineering materials and their methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe, and stone arches.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours a week, first semester.

Text: Baker, *Masonry Construction.*

13. Sewage and Drainage.

A study of the quantity of house-sewage and storm waters,

the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours a week, second semester.

Text: Folwell, *Sewerage.*

14. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisite: Course 9 and 12 of this department.

Time: Class-room, three hours a week, second semester.

15. Mine Constructions.

Under the head of Mine Construction, the application of the principles of Civil Engineering to the structures most frequently required in mining is taken up. Mine buildings, bins, head-frames, trestles, crane-girders, fast-plants, tanks, etc., are studied as to form and materials of construction. The stresses produced in the members of these structures by the various kinds of loading, and the calculations of these stresses by algebraic and graphic methods are taken up.

In the laboratory the problems incident to design are solved and typical structures are designed and finished drawings made.

Prerequisites: Course 4 of Department II, and Course 6 of this department.

Time: Class-room, three hours a week, one year.
Drafting-room, nine hours a week, one year.

Texts: Merriman and Jacoby, *Roofs and Bridges,* Parts I, II, and III.
Ketchum, *Walls, Bins, and Grain Elevators.*

16. Wood-shop.

The student is taught the use and care of wood working tools. Exercises in simple joints are then assigned and whenever possible useful exercises will be given.

Time: Work-shop, three hours a week, first semester.

17. Forging.

Exercises in drawing, shaping, upsetting, tempering, and welding. Some bench-work in chipping, filing, and rasping is also given.

Time: Work-shop, three hours a week, second semester.

18. Mechanical Drawing and Lettering.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented.

The latter part of the semester is devoted to special practice in lettering and free hand sketching.

Prerequisites: Entrance requirements.

19. Machine Drawing.

A continuation of Course 18. Here the student makes working drawings from machine parts already made; first while having the part directly before him, and later from a free-hand sketch of the part, without having the latter to look at while drawing. He thereby becomes familiar not only with methods of dimensioning, laying out and reading working drawings but also those of making and using sketches. Through the entire course, particular stress is laid on neat lettering, correct dimensioning, and symmetrical arrangement of drawings.

The student is also taught tracing and blue printing.

Prerequisite: Course 18 of this department.

Time: Laboratory, six hours a week, second semester.

Text:

20. Machine Design.

A study of the design of machine elements and modern ma-

chines, and of the nature, strength, and action under stress of the materials used in the machine construction. Recitations are carried on, including the discussion of problems suitable for illustration of important points. In the drafting room each student completes the design of some specially assigned simple machine.

Prerequisites: Courses 18 and 19 of this department; Course 6 of Department IV must precede or accompany.

Time: Class-room, two hours a week, second semester.
Laboratory: Six hours a week, second semester.

21. Descriptive Geometry.

The representation of all geometrical magnitudes are made possible by means of orthographic projection. The student is required to solve various problems involving points, lines, surfaces and solids and demonstrate same in exercises at the blackboard. A thorough knowledge of descriptive geometry is indispensable to the engineer.

Prerequisites: Course 2 of Department I, and Course 18 of this department must precede or accompany.

Time: Class-room, two hours a week, second semester.

Text: Church, *Descriptive Geometry.*

22. Steam Engines and Boilers.

In this course an elementary course in thermodynamics is given followed by the theory of the steam engine based on thermodynamics. This, in turn, is followed by a general descriptive course on engines and boilers, their types, details, construction and management. The whole course is supplemented by suitable problems to aid the student in his understanding and grasp of the subject.

Prerequisites: Courses 1 and 2 of Department II.

Time: Class-room, five hours a week, first semester.

Texts: Peabody and Miller, *Steam Boilers and Engines.*
Ripper, *Steam Engines.*

23. Hydraulics.

Under this head are treated fluid pressure, the principles of fluid equilibrium, and the laws governing the flow of water through orifices, over weirs, in closed conduits, and in open channels. The hydraulic laws relating to turbines and centri-

fugal pumps are briefly discussed, showing to what extent theory applies to these subjects.

Prerequisites: Course 4 of Department II and Course 6 of Department IV.

Time: Class-room, three hours a week, first semester.

Text: Merriman, *A Treatise on Hydraulics.*

24. Air Compression and Pumping.

Part 1: Discussion of pumping, pump problems, and pump details. Types of Pumps: Force pumps, crank and fly wheel, direct acting, duplex, compound, and triple expansion pumps.

Part 2: A study of the action of air during compression and expansion, its flow through pipes, and also of the various types of air compressing and actuating machinery.

Prerequisites: Course 22 of this Department and Course 2 of Department VI.

Time: Class-room, three hours a week, second semester.

Texts: Barr, *Pumping Machinery.*
Peele, *Compressed Air Plant.*

25. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, second semester.

Text: Johnson, *Engineering Contracts and Specifications.*

V. DEPARTMENT OF GEOLOGICAL ENGINEERING.

PROFESSOR ANDERSON.

This department aims to give its students knowledge concerning bodies of ore and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditions, so that mining may become more and more a business and that the element of chance may be lessened.

1. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals, rapid sight determination of unlabeled specimens being especially emphasized.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis

of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts, salts of the organic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 2 of Department III.

Time: Class-room, three hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Rogers, *Study of Minerals.*
Brush and Penfield, *Determinative Mineralogy and Blowpipe Analysis.*

2. General Geology.

All the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory work in the rock collections, and in study and interpretation of topographic maps, and frequent excursions into the field. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpertation of phenomena are discussed with considerable detail, train-

ing in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Limitar mountain, ten miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, first semester.
Laboratory, three hours a week, first semester.

Texts: Chamberlain and Salisbury, *College Geology.*
Scott, *Introduction to Geology.*

3. General Geology.

Discussion of theories of earth genesis, the principles of stratigraphy, and the geologic history of the development of the North American continent, involving laboratory work with type fossils and rock collections.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Text: Chamberlain and Salisbury, *College Geology.*

4. Field Geology.

Each student is assigned a limited area within the Socorro Quadrangle. Instruction is given in the field in observing and

recording geological phenomena and the preparation of map and sections. The collections made are then studied in the laboratory and a complete report describing the geology of the area is required.

Prerequisites: Course 3 of Department IV and Courses 1, 2, and 3 of this department.

Time: Saturdays, first semester.

5. Economic Geology.

This course embraces the study of the theories of ore deposition and the general features and formation of ore bodies and classification of ore deposits. This is followed by a description of the deposits of the ores of iron, copper, lead, zinc, silver, gold, and the lesser metals, with special reference to North America.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three hours a week, first semester.

Text: Kemp, *Ore Deposits of the United States and Canada.*

6. Economic Geology.

This course embraces the study of the non-metallic minerals of economic importance. A description of the distribution and occurrences of coal, petroleum, natural gas, asphalts, building stones, water supply, clays, cement rock, salt, gypsum, sulphur, fertilizers, abrasives, gems, and minor minerals.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three hours a week, second semester.

Collateral readings and reports on assigned topics are required of students in Mining Geology.

Time: Laboratory, three hours a week, one year.

7. Petrology.

A discussion of the origin, mineralogical and chemical composition, field classification and nomenclature, and miscroscopic structure of the crystalline, sedimentary, and metamorphic rocks. This is supplemented by field and laboratory work in the rock collections.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Kemp, *Handbook of Rocks and Lecture Notes.*
Luquer, *Rocks in Thin Sections.*

8. Geological Examinations and Surveys.

A discussion of the methods of systematically recording and interpreting geological phenomena, and the oragnization and scope of geological surveys. This is followed by a sketch of the history and results of state and national geological surveys in the United States, and of other sources of detailed information regarding local geology.

Prerequisites: Courses 1, 2, 3, 5 and 6 of this department.
Time: Class-room, two hours a week, second semester.

9. Ore Genesis.

The study of the paragenesis and origin of the minerals of a certain ore deposit. The student makes a collection of the deposit which is then studied in the laboratory by means of microscopic slides and polished surfaces and miscrochemical tests, etc.

Prerequisites: Courses 1, 2, 3, 4, 5, and 6 of this department.
Time: Laboratory, six hours a week, first semester.

10. Paleontology.

A study of the inverterbrate index fossils characteristic of the geologic horizons of North America.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second semester.
Text: Grabau and Shimer, *North American Index Fossils.*

11. Special Problems.

Research work in some branch of the science of geology, such as investigation in petrology, stratigraphy, paleontology, or ore deposits. This work may form the basis of a thesis in Geological Engineering.

Prerequisites: Courses 3, 5, 6, and 7 of this department.
Time: Laboratory, five hours a week, second semester.

VI. DEPARTMENT OF MINING ENGINEERING.

PROFESSOR STRIEF.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. The entire course is pre-eminently practical in character.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Prospecting by panning, trenches, test pits, boring and drilling. Testing of placers and ore deposits with well or chain drills.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts; quarrying.

Machine drills: Construction and operation.

Tunneling: Methods of driving and timbering; permanent linings; sizes, speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Methods of support: Pillars, timbers, filling.

Excursions are made to neighboring mines on Saturdays.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 1 of Department III.

Time: Class-room, three hours a week, first semester.

Texts: Foster *Elements of Mining and Quarrying.*
Lecture Notes.

2. Mining, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Ore extraction by systems of overhand and underhand stoping; caving by top slicing and sub-drifting; support of workings by filling and square-setting.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives.

Hoisting: Engines, drums, wire rope, skips and cages; head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Arrangements at top and underground landings: Ore pockets; signalling, etc.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiency of fans.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, three hours a week, second semester.

Texts: Same as in Course 1.

3. Elements of Mining.

This course covers, in a general way, the work included in Courses 1 and 2 of this department. Being intended for those specializing in Metallurgy, only the fundamentals of mining are given and the student is equipped to read mining literature understandingly. In case, later, he is lead into mining

work, he has the foundation upon which he can build up along the particular line in which he is interested. In this course the same trips are made that the regular students make in Course 1.

Prerequisites: Same as for Course 1 of this department.

Time: Class-room, three hours a week, first semester.

Text: Foster, *Elements of Mining and Quarrying.*

4. Mine Economics.

Among the subjects studied are: Factors governing the value of a mine; relation of labor, selling price of products, and profit; amortization of capital; ore sorting and its relation to profit; comparative efficiency of mining methods, plants, etc.; balancing the cost of mining equipments against the saving effected to see whether or not the installation is advisable.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Texts: Hoover, *Principles of Mining.*
Lecture Notes.

6. Ore Dressing.

This course includes a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil flotation.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 12 of Department VIII must precede or accompany.

Time: Class-room, three hours a week, first semester; two hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration.*

7. Mine Administration and Accounts.

Particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away

with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of supplies, mine accounts, statement of cost, and monthly reports are discussed.

Time: Class-room, two hours a week, second semester.

8. Examinations of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside construction, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant.

Time: Class-room, one hour a week, second semester.
Field, three hours a week, second semester.

9. Design of Mine Plant.

The student is assigned problems relating to a given mine. He makes the requisite surveys, plans the top-works, selects the requisite machinery for a specified duty, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or of the Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings.

Time: Laboratory, three hours a week, first semester; six hours a week, second semester.

VII. DEPARTMENT OF METALLURGICAL ENGINEERING.

PROFESSOR STRIEF.

The aim of the Metallurgical Department is to give its graduates a thorough working knowledge of assaying, chemistry, millwork and smelting processes; and to equip them with the knowledge necessary to the successful management of metallurgical plants, or to take charge of metallurgical operations.

This special training is given by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead. The crucible-assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assayers are considered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Course 3 of Department III, and Course 1 of Department V.
Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semteser.
Texts: Lodge, *Notes on Assaying.*

2. General Metallurgy.

This course is intended to give the mining engineer a broad general knowledge of metallurgy. After a brief discussion on fuels, refractories, and furnaces, the various methods of roasting an ore are considered. The balance of the semester is spent in studying the theory of the process, the plant required, and the mode of operation in the reduction of each of the following metals: gold, silver, copper, lead, iron, and zinc. Visits are made to neighboring plants.

Prerequisites: Course 1 of Department II, Course 1 of Department III; and Course 1 of Department V must precede or accompany.
Time: Class-room, three hours a week, first semester.
Text: L. S. Austin, *Metallurgy of the Common Metals.*

3. Principles of Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

Particular stress is laid upon the study of the more recent metallurgical practices and improvements of older processes. The course is supplemented by visits to neighboring plants.

Prerequisites: Course 1 of Department II; Course 1 of Department III; and Course 1 of Department V must precede or acompany.
Time: Class-room, three hours a week, first semester.
Text: Fulton, *Principles of Metallurgy.*

4. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and Eng-

lish methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet types of ore hearth; smelting lead ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.

Time: Class-room, two hours a week, first semester.

Text: Peters, *Principles of Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel process; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Texts: McFarren, *Cyanide Practice.*
Del Mar, *Stamp Milling.*

7. Metallurgy of Iron.

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron, gray cast-iron and spiegel-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Text: Stuoghton, *Metallurgy of Iron and Steel.*

8. Furnaces.

This course is given by way of an extension of the topic "furnaces" as treated in Principles of Metallurgy. It is concerned with the theories of high temperature generation, heat conservation, measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three hours a week, second semester.

Text: Damour, *Industrial Furnaces.*

9. Metallurgical Plant and Design.

The student devotes his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two students have the same work. The working plans for part of the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bills of materials made out for the portions of the work assigned, and the cost of the several parts carefully estimated according to the trade conditions and labor factors existing at the time. The entire work and all computations are carried out according to the best engineering practice and with the same care that actual construction operations require.

Prerequisites: Course 6 of Department IV; Course 6 of Department V; Course 23 of Department IV; and Course 2 of this department.

Time: Laboratory, three hours a week, first semester, and six hours a week, second semester.

10. Metallurgical Laboratory.

Laboratory work and investigation will be conducted along some of the following lines: Amalgamation of ores of gold and silver, chlorination of gold and silver ores, cyanidation of gold and silver ores, leaching methods for copper ores, electrolytic refining for copper and lead, slags.

Prerequisites: Courses 4, 5, 6, and 7 of this department must precede or accompany this course.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Mining and Metallurgical Trips.

During the first semester of the junior year a number of trips are taken to the mines, mills, and smelters which are within easy reach of the School. The officials at the various plants have been uniformly courteous in allowing the School the opportunity to make these visits, and have placed at the disposal of the students everything essential to a clear understanding of the mode of operation.

These excursions give the student a chance to see in operation and practice what heretofore he may have known only theoretically and give him a command of the subject that cannot be obtained in the class room.

Among the properties visited and at the disposal of the School are:

The old Torrance and Merritt mines, three miles from the campus, in the Socorro Mountains. These mines were once rich producers but are now being re-exploited.

The Merritt Mine has an incline shaft equipped with gasoline hoist and self dumping skip, and a considerable amount of drifting, raises, winzes, and stopes. Practically all the operations of mining may be seen at these two mines.

The coal mines at Carthage, New Mexico, are within easy reach of the School and present to the student difficulties, and their solution, in mining, haulage, ventilation, and water supply. The use of electricity in mining is prominently brought to the student's notice.

The zinc district at Kelly, New Mexico, brings out the fact that success in mining is not all luck. There are three large mines and two mills available for inspection, and the student sees in the mines that his geology is a live subject and essential to successful mining. In the mills, he gets his first insight into ore dressing and learns that there is more than one way of doing the same thing.

The Southwestern Portland Cement Company's plant at El Paso is visited and studied from the mechanical point of view. Here are seen in action various types of crushers, grinders, elevators, conveyors, feeders, etc. The company's quarry is a fine

example of open cut mining and the student sees the uses of churn drills in drilling holes for blasting large charges.

The Rio Grande Smelting Works at Socorro, closed down twenty years ago and partly dismantled, still gives a fine opportunity to see the construction of roasters and blast furnaces, one blast furnace having been completed ready to blow in, but never used.

At the smelter in El Paso, the student sees the working and handling of a large custom plant. Practically everything in the line of copper, lead, and silver smelting is before him for inspection. The methods of sampling, the blast roasting of lead ores, the roasting of copper ores, the blast furnace treatment of lead-silver ores, the blast furnace treatment of copper ores, the reverberatory smelting of copper ores, basic converting, casting machines, power houses, and assay offices are all made the subject of close observation.

Once in two years, a trip, open only to students who have taken work in the Mining or Metallurgical departments, is taken through the Southwest. The probably itinerary of this trip is as follows: Santa Rita, Hurley, Morenci, Clifton, Globe, Miami, Tombstone, Bisbee, Cananea, and Douglass.

VIII. DEPARTMENT OF LANGUAGES.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge, for in Soccoro and vicinity Spanish is as generally spoken as English.

1. Spanish.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercise each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language with the idea of learning the grammar from the language rather than the language from the grammar.

Time: Two hours a week, one year.

Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish.

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar* being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.

Time: Two hours a week, one year.

Instruction in Spanish is given by a Spanish-American who holds a scholarship in the institution. Such instructor is named at the beginning of the school year by the president.

ACADEMIC DEPARTMENT.

PRINCIPAL, GUNTER.

The requirements for admission to the Academy are the same as those for standard secondary schools. A two-year course is offered, the work therein corresponding to that of the ninth and tenth grades of the standard high school.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

FIRST YEAR—FIRST SEMESTER.

Elementary Algebra.

To the subject of simultaneous linear equations, including the four fundamental operations; factoring, including the determination of the highest common factor and the lowest common multiple; linear equations; and problems depending on linear equations.

Time: Five hours a week.

Text: Hawkes, Luby, and Touton, *Complete School Algebra.*

English I.

The Idyls of the King and The Lady of the Lake are read and discussed in class. The memorizing of some of the most significant passages is required. In composition work, an at-

tempt is made to interest the student at once in narrative writing, fluency and correct expression being sought primarily. Later in the year the work verges into exposition. During the semester, suitable selections from the best literature, both classic and modern, are read as supplementary to the above.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric*.

Physiography.

Wherever possible, in this course, facts obtained by actual observation are made to verify and supplement the text used. There are daily assigned observations of clouds, winds and temperature. A study of erosion by wind and water and of geologic formation is made. In connection with the study of stream-flow, attention is called to the great importance of forest preservation to the people of the West.

Time: Five forty-five minute periods a week.

Text: Dryer, *High School Geography*.

FIRST YEAR—SECOND SEMESTER.

Elementary Algebra.

Radicals, including the extraction of square root; exponents, including the fractional and negative; quadratic equations and problems depending on them, and the binomial theorem for positive and negative exponents.

Time: Five hours a week.

Texts: Wells, *Algebra for Secondary Schools*.
Hawkes, Luby, and Touton, *Complete School Algebra*.

English I.

In this subject, the work of the first semester is continued. The Merchant of Venice and Hamlet are read and discussed in class. As in the first semester, appropriate supplementary matter is read by each pupil.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric*.

Physiography.

The work during the second semester is a continuation of that

of the first. Notes are kept by each pupil, during the year, based on the text, and on practical observation and research.

Time: Five forty-five minute periods a week.

Text: Dryer, *High School Geography.*

SECOND YEAR—FIRST SEMESTER.

Plane Geometry.

The work in this subject for the first semester covers the usual theorems and constructions of good text books, including the general propositions of plane rectilinear figures; the circle and measurements of angles; similar polygons; areas; regular polygons, and the solution of numerous original exercises.

Time: Five hours a week.

Text: Wentworth and Smith, *Plane Geometry.*

English II.

During the first semester of the second year, Shakespeare's Tempest and George Eliot's Silas Marner are read and discussed in class. The work in composition and rhetoric is continued, including a study of the most important forms of prose and poetry, versification, and figures of speech.

Time: Five forty-five minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Physics.

This course runs throughout the entire year, the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. During this semester the subjects of mechanics, sound, and light are studied.

Time: Five hours a week in class, with three hours laboratory.

Text: Millikan and Gale's *First Course in Physics, with laboratory manual.*

History.

For the benefit of those who have not had the opportunity to

study Ancient History a brief review of that subject is made. Grecian and Roman History are given their proper emphasis. Special attention is paid to the History of Western Europe since the barbarian invasion, with emphasis on the bearing of old-world events upon the history of the Americans. In the study of such things as the mediæval town, life in the feudal castle and the Renaissance, an attempt is made to cause the student to realize these things as aspects of the daily existence of common men and women, which he would have lived likewise under like conditions, rather than to obtain a fixed mental chronology of dates and occurrences. Frequent written reviews are given throughout the course.

Time: Five forty-five minute periods a week.

Text: Renouf, *Outlines of General History.*

SECOND YEAR—SECOND SEMESTER.

Solid Geometry.

The work for the second semester includes the usual theorems and constructions of good text books covering the relations of lines and planes in space; the properties and measurements of prisms, pyramids, cylinders, and cones; the sphere; and the spherical triangle.

Time: Five hours a week.

Text: Wentworth and Smith, *Solid Geometry.*

English II.

During the second semester of the second year Julius Caesar and Milton's Minor Poems are read and discussed in class. A careful study of the history and development of English literature is made. Extracts from the classics are read and discussed. Notes are kept based on the text studied.

Time: Five forty-five minute periods a week.

Text: Long, *English Literature.*

Physics.

This is a continuation of the first semester's work. Heat and electricity are treated in much the same manner as the subjects of the first half of the year.

Time: Five hours a week.
Text: Carhart and Chute, *High School Physics.*

History.

This is a continuation of the first semester's work.
Time: Five forty-five minute periods a week.
Text: Renouf, *Outlines of General History.*

Drawing.

Instruction in elementary drawing is given during the entire second year in the Academic School. Such practice prepares the student for the more advanced work in the College courses.

Industrial Training.

Elementary shop practice is given academic students who are not otherwise overburdened with work. The scope and arrangement of shop work will be made by the instructor in charge. Students who do not intend to take a full college course will do well to take advantage of work in the shop.

BUILDINGS AND GROUNDS.

BUILDINGS AND GROUNDS.

The Campus.

The State School of Mines campus contains 20 acres of nearly level ground on the outskirts of the city of Socorro. Groves of trees have been planted and trees line the walks and drives.

Main Building.

The main building consists of three stories and a good basement. It is T-shaped, 135 feet long by 100 feet deep, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite in broken ashler and is trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated, heated with a good hot-water system, piped for water and gas, and wired for electricity for illumination and for experimental purposes.

As now arranged the main floor of this building contains the president's office, the mineralogical museum, the qualitative chemical laboratory and instructor's office, the assay laboratory and balance rooms, and a lecture room. The basement contains two lecture rooms, the physical laboratory, and instructor's private mineralogical laboratory, the quantitative chemical laboratory, the electro-chemical laboratory, an instructor's private chemical laboratory, the chemical supply rooms, a photographic dark room, the boiler room, the engine room, the hot water heating plant, and the lavatories. A lecture room, now occupied by the department of mathematics, is located on the second floor. The main library occupies the third floor.

Mechanical Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion the building is to be X-shaped, the central pavilion two stories and the four wings one story. With its spacious rooms it will be peculiarly adapted to mechanical training and instruction.

A blue print room is provided for in this building and is conveniently arranged and appointed for the needs of map reproduction.

Dormitory.

The State School of Mines suffered long for lack of dormitory accommodations. In fact, it is known that many students who would otherwise have come to the State School of Mines in years past went to other institutions because of the lack of the lower cost of living which a dormitory here would have afforded. However, the $15,000 generously appropriated by the territorial legislature was expended with the result that the School of Mines is equipped with what is probably the best dormitory in New Mexico. The building is heated with hot water and lighted with electricity. There are a dining room and kitchen in connection, also a bath room on each of the two floors and a shower bath in the basement. The assembly room, on the first floor, which is now equipped for the accommodation of the academic department, promises to meet all the requirements of that department for some time to come. The building is designd to afford accommodations for about thirty students and from time to time has been occupied to practically its full capacity.

Students are accommodated with board and lodging at the dormitory at the rate of $20 a month, they being required to furnish only their own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself, and no student will be accommodated in this way to the exclusion of another student from dormitory privileges. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture, After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application.

EQUIPMENT.

Chemical Laboratories.

The chemical laboratories have recently been greatly enlarged and improved. As now arranged they occupy the entire south wing of the main building, while the store room, private laboratory, and chemical lecture room are located in the central section of the same building. Elements of chemistry and qualitative analysis are taught in the large laboratory on the main floor. The room, which is exceptionally well lighted and ventilated, is equipped with large hoods, a balance room, and twenty-four desks, each of which is supplied with gas, water, and electric light.

The basement laboratory has recently been remodeled and fitted with large windows, glass partitions, and modern desks. The east half of it used for quantitative analysis and wet assaying. There are large hoods in each end which are supplied with hot plates and drying ovens, while each desk is equipped with an Alberine stone sink, water, gas, and electric light.

In the west half of the basement there are the instructor's laboratory, electro-chemical laboratory, and balance room. The latter is fully equipped with the best analytical balances supported upon a solid concrete table which is entirely free from vibration. The electro-chemical laboratory is supplied with current from a modern storage battery plant, consisting of a motor-generator, storage cells, and a switch-board so arranged that each student may obtain any current he desires for analytical or other electro chemical experiments. There is also a supply of alternating current from the city circuit which is used for light and small electric furnaces.

The laboratory is very completely equipped not only with all apparatus, chemicals, and supplies needed for the various courses, but the stock includes a large amount of pure chemicals and special apparatus, including standardized burettes, flasks, and weights which are used for the most accurate rock analysis and research work.

All apparatus is loaned to the students. Chemicals and supplies are furnished at cost.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types and large muffle coal and coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes, and other assaying materials and supplies.

A weighing-room containing a number of Becker's balances is conveniently located between the furnace-room and the lecture-room. In the grinding room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher and a Bolthoff sample-grinder and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers, and other necessary apparatus.

Physical Laboratory.

The physical laboratory occupies the east side of the north basement of the main building and contains the usual apparatus for illustrating the facts and laws of physics. In addition there has just been added at a considerable expense all the apparatus necessary to perform the quantitative experiments outlined in Course 2 of Department II.

Petrographical Laboratory.

For the miscroscopic study of rocks both in elementary and advanced or graduate work the School is well supplied with rocks in thin sections representing the various types of igneous, metamorphic, and sedimentary rocks accompanied by hand specimens, giving the student an opportunity to study the microscopic and megascopic characters of the rocks at the same time. The laboratory is well equipped with standard up-to-date microscopes with all accessories; also, a camera for microphotographic work with accessories for oblique and vertical illumination; also, a rock slicing machine with electric power attachment where the students in petrography are taught how to make and mount thin sections.

Mineralogical Laboratory.

For the study of minerals by physical characters and blow

pipe test, the School is especially well provided with an abundance of material of various ores and minerals for blow pipe determinations. Large collections for this purpose have recently been added to the School and the minerals are so arranged that no two students work with the same minerals the same day, thereby stimulating thorough systematic search for the elements and correct determination of the mineral specimens. The laboratory is well equipped with all necessary apparatus to carry on this work in an efficient and up-to-date manner.

Mineralogical Museum.

The mineralogical Museum, with instructor's office, occupies the entire north wing of the first floor of the main building. The School owns a very fine collection of minerals and rocks of all kinds. These are arranged systematically, forming units for the various courses in Geology rather than for showy display. The minerals and rocks from the various mining districts are segregated, thereby giving the student the best possible opportunity of studying the ores and rocks of a district without having actually visited the field. The Museum is well supplied with such district collections throughout the United States, Mexico, and Canada. New specimens are being added most every day in the year.

ENGINEERING INSTRUMENTS.

The Civil Engineering Department has all the instruments necessary for land, railroad, irrigation, mine, and topographic surveys. These include chains, tapes, range-poles, level rods, wye and dumpy levels, complete transits, and plane tables. In purchasing instruments for this department only the best grade has been considered and the student has the opportunity to become familiar with the product of such well known manufacturers as Gurley & Sons, Eugene Dietzgen, Buff & Buff, etc.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the mechanical building. Opening off from it are the instructor's

office, supply-room, blue-print room with large printing frame on steel track, developing-vat, and drying rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. An Ingersol-Rand drill and other pieces of machinery are used as models.

LIBRARIES.

The libraries of the New Mexico State School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats, and atlases, and volumes on history, travel, and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.
Mining and Scientific Press.
Engineering Record.
Power.
Engineering News.
Mining Science.
The Mining World.
Mines and Minerals.
Engineering Magazine.
Journal of the American Chemical Society.
Journal of Industrial and Engineering Chemistry.
Chemical Abstracts.
Geographic Magazine.
Economic Geology.
School of Mines Quarterly.
New Mexico Journal of Education.
All the U. S. Geological Survey Publications.
U. S. Bureau of Mines Publications.
Canadian Geological Survey Publications.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully

chosen treatises, text-books, monographs, special contributions and author's separates, pertaining to the respective divisions.

Powell Library.—The School has come into possession of the private library of the late Major John W. Powell of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology, philosophy and many rare monographs of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who has been so long identified with this western country, should find a permanent home in New Mexico.

SOCORRO MOUNTAIN MINES.

The gold and silver mines at the base of Socorro mountain, only about two miles west of the School campus, afford excellent opportunities for the practice of mine-surveying and for a study of some features of practical mining. The ore-bodies with associated geological structures and many other features will interest the student of mining engineering.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is fifteen dollars a semester except to citizens of New Mexico, the tuition fee for the latter being five dollars a semester. This is payable at registration and its payment

after matriculation admits the student to all class-room instruction. Students who hold scholarships pay no fee for tuition.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Quantitative Analysis, Water and Fuel Analysis, Inorganic Preparations, Organic Chemistry, Electro-Analysis, Photography, Physics, each $5.00; Qualitative Analysis, Ore Analysis, each $7.50; Fire Assaying, $10.00; Mineralogy (Blowpipe Analysis) $3.00; Metallurgical Laboratory, $3.00; Shop, $2.00; Mine examination, $1.00.

A deposit of $2.00 is required from each student who registers for any of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due from the breakage of apparatus.

Graduation Fee.

The graduation fee, payable after delivery of diploma, is as follows:

Mining, Metallurgical, Geological or Civil Engineer......	$10.00
Bachelor of Science....................................	5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month; board at the hotels and best boarding-houses for $7.00 a week. The cost of living at the dormitory is $20 a month.

Books and Other Supplies.

Books and other supplies for students are furnished through the office at publishers' prices with the freight or express charges added. A considerable saving is thus made in behalf of the student.

Summary of Annual Expenses.

A close approximation of a student's necessary annual expenses is tabulated below. By the practice of extreme economy

a student may, of course, cut his expenses somewhat below the figures here given.

Board and room at the dormitory	$180.00
Books and other supplies	60.00
Laboratory and other fees	25.00
Total	$265.00

SCHOLARSHIPS.

There are a number of scholarships available each year in this institution which carry with them certain emoluments in cash and free tuition.

Teaching Scholarships.—Through the wisdom of the Board of Regents of the School of Mines there have been provided from two to five scholarships, discretionary to the president, carrying free tuition and from $150 to $200 per year. These scholarships are awarded only to worthy young men who have satisfactorily completed at least the College freshman work and who are otherwise worthy of recognition. The students carrying such scholarships shall be selected by the president, and they shall be required to give from one hour to not more than two hours instruction in the class room during the active school year, in the Academic or such work in the College as they may be qualified in or are capable of doing.

School of Mines County-Scholarships.—Scholarships are open to one student from each county in New Mexico. These scholarships yield free tuition and are awarded by the president to indigent and worthy students.

New Mexico Scholarships.—The Thirty-seventh General Assembly of New Mexico gave to each representative, to each councilman, and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the state (territory) and provided an appropriation of $200.00 for each appointee. The last legislature failed to make any appropriation for this purpose.

Allis-Chalmers Scholarship.—To one member of each year's

graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opportunity for four months' study and empolyment in any of its plants and an emolument of $150.00. This scholarship is awarded by the Board of Regents on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

SUMMER WORK.

The proximity of the School to mineral properties, mines, and smelters makes it easy for the student to secure employment during the summer and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining, have been attractive fields of work for the students during the vacations.

DEGREES.

The degrees of Bachelor of Science, Mining Engineer, Metallurgical Engineer, Geological Engineer, and Civil Engineer are conferred by the Board of Regents upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curiculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of the institution, have completed the prescribed collegiate courses of any one of the several curricula.

This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed course of the four-year curriculum in Mining Engineering, has presented an original and satisfactory dissertation in the line of his work, and has done two years of professional work of which one has been in a position of responsibility. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum, and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Metallurgical Engineer, Geological Engineer, and Civil Engineer is offered upon terms similar to those required in the case of the Mining Engineer.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but in each case the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidence of independent investigation to warrant its publication in whole or in part.

CHEMICAL ANALYSIS, ASSAYING, AND ORE TESTING.

The wide demand which exists in the great mining districts of the Southwest for disinterested and scientific tests and practical investigations has led to the establishment by the New Mexico State School of Mines of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible and accurate

results assured by reason of the exceptional facilities of the laboratories of the School and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A spcial Act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines." By special resolution it is required that all charges shall be paid in advance. Prices for work will be sent on application.

FREE DETERMINATIONS.

For the benefit of prospectors and others, elementary blowpipe and physical tests will be made of any rocks, ores or other mineralogical material when sent to the School for their proper classification and determination. Such work is done to encourage prospecting and to more fully exploit the mineral resources of New Mexico, so little comprehended at the present time. For such work as indicated in this paragraph no charges will be made.

CALIFORNIA-PANAMA EXPOSITION.

New Mexico was the first state to begin construction of its building at the San Diego Exposition. For a model the State Board of Exposition Managers took the historic church on the Rock of Acoma, adding to it a veranda and balustrade of the Franciscan Mission at Cochiti. This combination has provided a structure for New Mexico's exhibit that is the most striking of all exposition buildings, and one that is quite in harmony with the general architecture of the San Diego Exposition.

The location of the New Mexico building on the Exposition site in Balboa Park is on an eminence to the south and west of the main group of exhibit buildings, on the edge of a canyon, and with a commanding view of the ocean, bay, city and mountains. Its striking proportions are plainly seen by all visitors to the Exposition grounds, from the great viaduct which forms the approach from the west. It completes a picture that is absolutely beautiful and unique.

The New Mexico Board of Exposition Managers early decided that the most effective way of presenting the varied industries and natural resources of the state to those who visited San Diego in 1915 would be by carefully prepared lectures, supplemented with colored stereopticon views and moving picture scenario. Such lectures will be carried on during the whole time of the Exposition. Among the many interesting industrial features portrayed in moving pictures will be that of mining. The great mining enterprises, carried on by some of the largest operators in the world, in gold, copper, iron and coal, are certain to prove impressive sights in conveying to the mind something of the marvelous mineral wealth of the state. The output from the mines of New Mexico will reach approximately $20,000,000 in 1915.

In addition to the scenario illustrating the varied mining industries, there will be a comprehensive collection of the rare and economic minerals of the state displayed in exhibit hall in the New Mexico building throughout the life of the Exposition.

A publicity mining bureau will be established and every effort will be extended in supplying literature, maps, and like information to those interested in the geology, mineralogy, and mining economics of the state.

President Fayette A. Jones of the School of Mines has been appointed Mining Commissioner by the New Mexico Board of Exposition Managers and will have direct charge of collecting and assembling the mineral and geological exhibit as above indicated. It is thus seen that the New Mexico State School of Mines is officially connected with the San Diego Exposition and much good is expected to redound from this relation both to the school and in the further development of the mineral resources of the commonwealth.

DIRECTORY OF GRADUATES AND STUDENTS

DIRECTORY OF GRADUATES AND STUDENTS†

ARTHUR H. ABERNATHY El Paso, Texas.

Student, 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, Cananea, Sonora, Mexico, 1901; Assistant sampleman, Minera de Penoles Company, Mapimi, Durango, Mexico, 1909-1910; Sampling foreman same company, 1910-1913; Contractor, El Paso Smelter, 1913—.

ANTONIO ABEYTA

Entered 1908, from Socorro, New Mexico. Candidate for B. S. degree in Metallurgical Engineering.

M. DIEGO ABEYTA

Entered 1913, from Socorro, New Mexico. Academic department.

RAY COOK AHNEFELDT

Entered 1913, from Riverside, Cal. Candidate for B. S. degree in Civil Engineering.

JOHN K. ASHBY

Entered 1913, from Charleston, W. Va. Special.

GEORGE C. BAER Mogollon, New Mexico.

(B. S. in Mining Engineering, New Mexico School of Mines, 1910.)

Student, 1907-1910. From Hillsdale, Michigan. Assayer, Tri-Bullion Company, Kelly, New Mexico, 1910; Millman, Socorro Mines Company, Mogollon, New Mexico, 1911; Mill foreman, same company, 1912; Engineer, same company, 1912—.

C. E. BARCLAY Maria, Texas.

(A. B., University of Virginia.)

Student, 1896-1897. From Bowling Green, Kentucky.

SIDNEY BARTLETT

Entered 1914, from Socorro, New Mexico. Academic Department.

JAMES HENRY BATCHELDER, Jr. Socorro, New Mexico.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)

Student, 1906-1910. From Exetor, New Hampshire. Mining, Chloride, New Mexico, 1911; Farming, San Acacio, New Mexico, 1911—.

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†Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

THOMAS HORTON BENTLEY Calgary, Alberta, Canada.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)

Student, 1907-1910. From Burro Mountains, New Mexico. Surveyor with Mildon & Russell, Nacozari, Sonora, Mexico, 1910; General engineering work, Hermosillo, Sonora, Mexico, 1911; Mining Engineer, Portland, Oregon, 1911; Assistant superintendent, Norton Griffiths Steel Construction Company of London, England, with headquarters at Vancouver, British Columbia, Canada, 1912; Superintendent, same company, with headquarters at Calgary, Alberta, Canada, 1912—.

IGNATIUS LOYOLA BERRIEN

Entered, 1911, from El Paso, Texas. Sophomore class.

JAMES FIELDING BERRY Angangueo, Michiocan, Mexico.

Student, 1904-1905. From Socorro, New Mexico. Assayer, American Smelting & Refining Company, Aguascalientes, Mexico, 1905; Assayer, City of Mexico, Mexico, 1906-1907; Chemist, Cia Metalurgica y Refinadora del Pacifico, Fundicion, Sonora, Mexico, 1908; Assistant mine superintendent, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1909—.

LOUIS AUGUST BERTRAND Upland, Nebraska.

Student, 1895-1896. From Conway, Iowa. Student, Ecole Professionalla de l'East, Nancy, Lorraine, 1890-1894. Instructor in Mathematics and French, New Mexico School of Mines, 1895-1896; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and surveyor, Consolidated Kansas City Smelting & Refining Company, Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Mine superintendent, Minera de Penoles Company, Mapimi, Durango, Mexico, 1901.

MAURICE BREEN

Entered, 1912, from El Paso, Texas. Academic Department.

CONY C. BROWN

Entered, 1908, from Socorro, New Mexico. Special.

JOSEPH BROWN, Jr.

Entered, 1912, from Kelly, New Mexico. Academic Department

H. LAWRENCE BROWN Los Angeles, California

Student, 1903-1905. From Chicago, Illinois. Positions: Assayer, Ernestine Mining Company, Mogollon, New Mexico; Engineer, Cia Concheno Beneficiador, Mexico; Mill superintendent, Milwaukee Gold Extraction Company, Phillipsburg, Montana; Engineer, Transvaal Copper Company, Sonora, Mexico; Manager, Morning Star Mining Company, Ophir, Colorado; Manager, San Carlos Min-

ing Company, Sonora, Mexico; Manager of six properties and consulting engineer, Cobalt, Ontario, Canada; Superintendent, Haile Gold Mine, Kershaw, South Carolina; Exploration work in Venezuela, South America; Mill superintendent, National Mining Company, National, Nevada; at present, mining engineer with the American Metal Company with headquarters at Los Angeles, California.

THOMAS COBURN BROWN

Entered, 1910, from Socorro, New Mexico. Special.

CLARA BURSUM

Entered, 1913, from Socorro, New Mexico. Academic Department.

CHAUNCEY E. BUTLER*

Student, 1893-1894, from Kelly, New Mexico. Assayer, Cibolo Creek Mill & Mining Company, San Francisco, California, 1896; Assayer and furnace superintendent, La Compania Minera Lustre, Magistral, Durango, Mexico, 1897-1898; Chemist and assayer, United Verde Copper Company, Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Company, and Jenny Lind and Maple Mining Company, Dedrich, California, 1903.

BEONARD M. BUTCHOFSKY

Entered, 1912, from El Paso, Texas. Academic Department.

PHILLIP A. CAMPREDON

Entered, 1910, from Socorro, New Mexico. Junior class.

R. HARLAND CASE — Deming, New Mexico.

Student, 1902-1905, from Cerrillos, New Mexico. Chemist, Compania Metalurgica de Torreon, Coahuila, Mexico, 1905-1906; Assistant superintendent, Bonanza Mines, Zacatecas, Mexico, 1906; Assistant manager, Stephenson-Bennett Mining and Milling Compay, Organ, New Mexico, 1906-1907; Consulting engineer, Western Mining, Milling & Leasing Company, Colorado Springs, Colorado, 1907-1908.

EDWARD C. CHAMNEY — Minnehaha, Arizona.

Student, 1899-1900, from Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-1901; Assayer, Oro Mining Company, Minnehaha, Arizona, 1901.

VIVIAN V. CLARK — Seattle, Washington.

Students, 1896-1898, from Kelly, New Mexico. Assayer, Bland Mining Company, Bland, New Mexico, 1898-1899; Superintendent,

*Deceased.

Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine operator, Albuquerque, New Mexico, 1902; Manager Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903-1908; Consulting Engineer, Consolidated Exploration Mines Company of New York, and allied syndicates, 1909-1910; President, Northern Engineering Company, Seattle, Washington, 1910-1912; President, Clark Mining Machinery Company, successors to Northern Engineering Company, 1912—.

DAVID JOSHUE CLOYD Saltillo, Coahuila, Mexico.

Student, 1899-1900. From Decatur, Illinois. Chemist and assayer, Wardman's Assay Office, Aguascalientes, Mexico, 1900-1906; Assistant superintendent, Cia. Minera del Tiro General, and assistant superintendent, Cia. del Ferrocarril Central de Potosi, Charcas, San Luis Potosi Mexico, 1906-1908; Assayer and chemist, Dailey, Wisner & Company, Torreon, Coahuila, Mexico, 1908; Chief assayer and chemist, Mazapie Copper Company, Saltillo plant, Saltillo, Coahuila, Mexico, 1911—.

SAMUEL COCKERILL Indianapolis, Indiana.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-1906. From North Fork, Virginia. Post-graduate engineering course, Allis-Chalmers Company, 1907-1908; Milwaukee Coke and Gas Company, Milwaukee, Wisconsin, 1908-1910; Citizens Gas Company, Indianapolis, Indiana, 1910—.

HARMON COOPER

Entered, 1914, from Socorro, New Mexico. Academic Department.

WALTER ALFRED DAVENPORT

Entered, 1912, from Nashville, Illinois. Special.

JOHN F. DEMPSEY

Entered, 1912, from Santa Rita, New Mexico. Academic Department.

LEON DOMINION New York, New York.

(B. A., Roberts College, Constantinople, 1896; C. I. M., Mining School, University of Liege, 1900.)

Graduate student, 1903-1904. From Constantinople, Turkey. Assistant, United States Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-1904; Engineer, Victor Fuel & Iron Company, Denver, Colorado, 1904-1906; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-1907; Consulting Engineer, Mexico City, Mexico, 1908-1909; Consulting engineer, New York City, 1910.

MARJORIE DOUGHERTY

Entered, 1913, from Socorro, New Mexico. Academic Department.

LLOYD JESSE DRAKE

Entered, 1913, from Albuquerque, New Mexico. Academic Department.

ROBERT CASIANO EATON*

Student, 1893-1894. From Socorro, New Mexico. Sampling mill foreman, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1894-1898; Superintendent, Muriedas Smelting Works, Xichu, Guanajuato, Mexico, 1898; Superintendent, Pozo del Carmen Ferrocarril, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager, Nuevo Cinco Senores Mining and Milling Company, Camanja, Jalisco, Mexico, 1902-1904; Independent assayer and ore buyer, Leon, Guanajuato, Mexico, 1904-1910.

ALEXANDER WALTER EDELEN Angangueo, Michiocan, Mexico.

Student, 1905-1906. From Baltimore, Maryland. Assistant superintendent, Elkton Consolidated Mining & Milling Company, Elkton, Colorado, 1906-1907; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1907-1908; Mine superintendent, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1909—.

ALEDRSON BURGHR EVERHEART

Entered, 1912, from Bells, Texas. Special. Assayer, San Xavier Mine, Tucson, Arizona, 1913—.

PRESTON PALMORE EVERHEART

Entered, 1913, from Socorro, New Mexico. Academic Department.

THADDEUS BELL EVERHEART Socorro, New Mexico.

Student, 1905-1907. From Bells, Texas. Assayer and surveyor, Pereguina Mining and Milling Company, Guanajueto, Mexico, 1907-1908; Mill superintendent, Las Animas Mining and Milling Compay, Pueblo Nuevo, Durango, Mexico, 1908-1910; Mining, Cloride, New Mexico, 1911.

LEOPOLD E. FLEISSNER Milwaukee, Wisconsin.

(B. S., E. M. in Mining Geology, New Mexico School of Mines, 1912.))

Student, 1910-1912. From Manistee, Michigan. Engineer, Sterling Engineering & Construction Company, Milwaukee, Wisconsin, 1912-1913; Engineer, Ray Consolidated Copper Company, Ray, Arizona, 1913—.

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*Deceased.

JOHN ELLMER FULLERTON

Entered, 1912, from Datil, New Mexico. Special.

HARRY THORWALD GOODJOHN Torreon, Coahuila, Mexico.

Student, 1902-1903. From Pittsburg, Texas. Assayer, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1903-1906; Chief Chemist, Minera de Penoles Company, Mapimi, Durango, Mexico, 1906; Chemist and metallurgist, Cia. Minera, Fundidora, y Afinadora, Monterey, Mexico, 1907-1908; Chief chemist, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1909—.

SAMUEL JAMES GORMLEY West Jordan, Utah.

Student, 1895-1896. From Mt. Vernon, Iowa. Assistant professor of Engineering, New Mexico School of Mines, 1895-1896; Assistant assayer, Anaconda Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist, same company, 1900-1902; Superintendent of sampling works, Washoe Smelting Company, Anaconda, Montana, 1902-1906; Smelter superintendent, Bingham Copper & Gold Mining Company, West Jordan, Utah, 1906.

EDWIN CLARENCE HAMMEL.

Entered, 1912, from Socorro, New Mexico. Academic Department.

HENRY ROOT HARRIS.

Entered, 1908, from Socorro, New Mexico. Candidate for B. S. degree in Mining Engineering.

MARJORIE HERRICK

Entered, 1912, from Socorro, New Mexico. Academic Department.

AUGUST HILTON

Entered, 1913, from Socorro, New Mexico. Academic Department.

ROSEMARY HILTON

Entered, 1912, from Socorro, New Mexico. Academic Department.

RUE N. HINES*

(B. S., New Mexico School of Mines, 1907.))

Student, 1904-1907. From Socorro, New Mexico. Superintendent West Coast Mining & Smelting Company, Mocorito, Sinaloa, Mexico, 1907-1909; Locating and developing prospects in Arispe District, Sonora, Mexico, 1910; Secretary, First Mortgage & Security Company, El Paso, Texas, 1911.

*Deceased.

INNOKENTY J. HLEBNIKOFF

Entered, 1912, from Blagoveshensk, Russia. Special.

EDMUND NORRIS HOBART Morenci, Arizona.

(B. S., New Mexico School of Mines, 1910.)

Student, 1906-1908, 1909-1910. From Clifton, Arizona. Chemist, Socorro Mines Company, 1909; Chief sampleman, Shannan Copper Company, Clifton, Arizona, 1910-1911; Assistant surveyor, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1911; Resident engineer, Capistante Mines Group, Mazapil Copper Company, Limited, Concepcion del Oro, Zacatecas, Mexico, 1912; Chief engineer, Charcas Unit, American Smelting & Refining Company, Charcas, San Luis Potosi, Mexico, 1913-1914; Mining engineer, Phelphs-Dodge Company, Morenci, Arizona, 1914—.

ANTON HOGWALL Nogal, New Mexico.

Student, 1898-1899. From White Oaks, New Mexico. Assayer, Buckeye Mining Company, Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Company, and Helen Rae Mining Company, White Oaks, New Mexico, 1901; American Gold Mining Company, Nogal, New Mexico, 1902.

CARL JOHN HOMME Glendale, Oregon

(A. B., St. Olaf College.)

Graduate student, 1899-1900. From Wittenburg, Wisconsin. Assayer and chemist, Candelaria Mining Company, El Paso, Texas, 1900-1901; Assistant superintendent, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902.

WILLIAM ELIAS HOMME Glendale, Oregon.

(A. B., St. Olaf College.)

Graduate student, 1902-1903. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. HOWELL Santa Fe, New Mexico.

Student, 1900-1905. From Socorro, New Mexico. Civil engineer on railway from Acapulco, Mexico, 1906-1907; Civil engineer, Mexican Central R. R., 1907-1912; Assistant to state engineer, Santa Fe, New Mexico, 1913—.

HARRY J. HUBBARD Rosario, Sinaloa, Mexico.

(B. S., New Mexico School of Mines, 1906.)

Student, 1905-1906. From Bisbee, Arizona. Mine foreman, Navidad Mine of Greene Gold-Silver Company, Concheno, Chihuahua, Mexico, 1906; Chemist, same company, 1906; Assistant mill superintendent, Sahuanycan Mining Company, Sahuanycan, Chihuahua,

Mexico, 1906; Machine drill foreman, Sirena Mine, Guanajuato, Mexico, 1907; Shift boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan and associates in southwestern states of Mexico, 1907; Tramway superintendent, Bonanza Mine, Zacatecas, Mexico, 1908; Foreman, Butters Divisavero Mines, Jocoro, San Salvador, Central America, 1909-1910; Superintendent, Las Animas Mining Company, Hermosilla, Sonora, Mexico, 1910; Foreman, Minas del Tajo, Rosario, Sinaloa, Mexico, 1911—.

JOHN AUGUST HUNTER Denver, Colorado.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro, New Mexico. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-1904; Chemist and metallurgist, American Smelting and Refining Company, Aguascalientes, Mexico, 1904-1908; Metallurgist, Congress Mining Company, Congress, Arizona, 1909-1910; Assayer, Los Angeles, California, 1910-1911; Engineer, Pioneer Mining Company, Tucson, Arizona, 1911-1912; Engineer, American Zinc Ore Separator Company, Denver, Colorado, 1912—.

WALTER JOHANNESSEN

Entered, 1913, from Washington, D. C. Candidate for B. S. degree in Civil Engineering.

FRANK A. JOHNSTON New Bloomfield, Pa.

Entered, 1911, from New Bloomfield, Pennsylvania. Secured B. S. degree in Civil Engineering, 1913.

PATRICK COONEY LEWIS

Entered, 1913, from Socorro, New Mexico. Academic Department.

JOSEPH POWELL LILES

Entered, 1910, from Socorro, New Mexico. Academic Department.

CHARLES THAYER LINCOLN New York, New York.

(B. S., Masachusettes Institute of Technology, 1901.)

Graduate student, 1902-1903. From Boston, Massachusettes. Chemist, Bell Telephone Company, 1901-1902; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-1903; Acting professor, same, 1903-1904; Instructor in Chemistry, Iowa State University, Iowa City, Iowa, 1904-1905; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-1907; Chemist, Arbuckle Brothers Sugar Refinery, Brooklyn, New York, 1907-1909; Chemist, United States Custom Service, New York, New York, 1910—.

FRANCIS CHURCH LINCOLN New York, New York.

(B. S., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1903.)

Assayer, San Bernardino Mining Company, 1900; Chemist, Butterfly Terrible Gold Mining Company, 1900-1901; Professor of Metallurgy, New Mexico School of Mines, 1902-1904; Assistant superintendent, Ruby Gold & Copper Company, Ortiz, Senora, Mexico, 1904; General manager, Arizona Gold & Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907-1910; Mining engineer, New York, New York, 1911—.

IRENE GRACE LAFFONT

Entered, 1912, from Socorro, New Mexico. Academic Department.

RAFAEL LOPEZ

Entered, 1912, from Socorro, New Mexico. Academic Department.

HORACE T. LYONS Globe, Arizona.

Entered, 1908, from El Paso, Texas. B. S. degree in Mining Engineering, 1913.

HARRY C. MAGOON Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer, Illinois Steel Company, Chicago, Illinois, 1911.

FRANK MALOIT

Entered, 1911, from Elmhurst, Illinois. Junior class.

LLOYD L. MAYER

Entered, 1912, from Socorro, New Mexico. Academic Department.

STANLEY ANTON MAYER

Entered, 1914, from Socorro, New Mexico. Academic Department.

CONRAD C. MEYER New York, New York.

(A. B., New York University; M. D., Bellevue Hospital.)

Graduate student, 1900-1901. From New York, New York.

DANIEL M. MILLER Lake Valley, New Mexico.

(B. S., New Mexico School of Mines, 1909.)

Student, 1906-1909. From Lake Valley, New Mexico.

TARVER MONTGONERY Santa Ana, California.

Student, 1899-1900. From Santa Ana, California. County sur-

veyor, Orange county, California, 1900-1901; Assistant engineer, Temescal Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles & Salt Lake Railroad Company, 1901-1902; Assistant engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

EARLE GIBBON MORGAN Guadalajara, Jalisco, Mexico.

(E. M., New Mexico School of Mines, 1911.)

Student, 1907-1908, 1910-1911. From Lansdowne, Pennsylvania. Pennsylvania State College, 1908-1910. Engineer, Socorro Mines Company, Mogollon, New Mexico, 1911-1912; Assistant engineer, same company, Guadalajara, Jalisco, Mexico, 1912—.

ERLE D. MORTON Los Angeles, California.

(E. M. in Mining Geology, New Mexico School of Mines, 1909.)

Student, 1903-1905, 1908-1909. From Los Angeles, California. Assistant superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-1906; Washington University, 1906-1907; Mine examiner, Los Angeles, California, 1907-1908; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908; Mine superintendent, Arizona & Nevada Copper Company, Luning, Nevada, 1909-1910; Mining engineer, Los Angeles, California, 1910; Chief engineer, Lone Mountain Tunnel Company, Superior, Montana, 1911-1912; with Braun Corporation, Los Angeles, California, 1912-1913; Assistant superintendent, Elko-Prince Mining, Gold Circle, Elko County, Nevada.

WILLIAM FREDERICK MURRAY Delagua, Colorado.

Student, 1904-1906. From Raton, New Mexico. In chief engineer's office, Victor Fuel Company, Denver, 1906-1907; Assistant engineer, Victor Fuel Company, 1907-1908; Assistant to chief and traveling engineer, Victor Fuel Company and Colorado & Southwestern Railway Company, 1908; Assistant engineer, Hastings Mine, Victor Fuel Company, Hastings, Colorado, 1909-1910; Superintendent, Cass mine, Victor American Fuel Company, Delagua, Colorado, 1910-1913; Assistant general superintendent, Colorado Division, the Victor American Fuel Company, Trinidad, Colorado, 1913—.

HOMER McBRIDE

Entered, 1914, from Socorro, New Mexico. Academic Department.

LEO MACDONALD

Entered, 1913, from Kelly, New Mexico. Academic Department.

LLOYD A. NELSON

Entered, 1911, from Santa Rita, New Mexico. Freshman class.

CLYDE M. NEY

Entered, 1912, from Madisonville, Louisiana. Academic Department.

ANTHONY FRANCIS O'BOYLE

Entered, 1912, from Rice, Arizona. Freshman class.

MARTIN J. O'BOYLE

Entered, 1910, from Rice, Arizona. Junior class.

PATRICK J. O'CARROLL*

(A. B., University of Dublin, Ireland.)

Graduate student, 1898-1899. From Dublin, Ireland. Mine operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN*

(B. S., New Mexico School of Mines, 1896.)

Student, 1895-1896. From Butte, Montana. Assistant superintendent, Philadelphia Mines, Butte, Montana, 1896-1897.

JUAN PALISSO — Mexico.

Student, 1903-1904. From Barcelona, Spain. Mining engineer, Mexico.

ORESTE PERAGALLO — Tepec, Mexico.

(E. M., New Mexico School of Mines, 1908.)

Student, 1907-1908. From Ciudad Juarez, Chihuahua, Mexico. Mining engineer, El Paso, Texas, 1908-1910; Graduate student, New Mexico School of Mines, 1910-1911; Mining engineer, El Paso, Texas, 1911-1912; Chemist, Tepec, Mexico, 1912—.

FOUNT RAY — Italy, Texas.

Student, 1901-1902. From Waxahachie, Texas. General manager, Lena Mining & Concentrating Company, Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902-1912; Real estate business, 1912—.

DANIEL FRANCIS RECKHART

Entered, 1913, from El Paso, Texas. Special.

ALBERT BRONSON RICHMOND — Tucson, Arizona.

Student, 1900-1901. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gabilan, Sonora, Mexico, 1901-1902; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and metallurgist, Patagonia, Arizona; General manager, Mansfield Mining & Smelting Company, Patagonia, Arizona,

*Deceased.

1908; Consulting engineer, Tucson, Arizona, 1909; Field engineer, Mines Company of America with headquarters at Tucson, Arizona, 1910—.

DELL FRANK RIDDELL Parral, Chihuahua, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; E. M., New Mexico School of Mines, 1905.)

Graduate student, 1903-1905. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, Sioux Falls, South Dakota, 1901-1903; Instructor in Chemistry, New Mexico School of Mines, 1903-1904; Acting professor of assaying, same, 1904-1905; Holder of Allis-Chalmers Scholarship, 1905-1906; Engineer, Universam Pump & Manufacturing Company, Kansas City, Missouri, 1906-1907; Superintendent, Benito Juarez Mine, Parral, Chihuahua, Mexico, 1907-1908; Consulting engineer and acting superintendent, Providentia Mines Company, Parral, Chihuahua, Mexico, 1908.

SOREN RINGLUND

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1910-1912. From Ceresco, Nebraska. Engineer, Empire Zinc Company, Kelly, New Mexico, 1912—.

ORLANDO DOUGLAS ROBBINS Depue, Illinois.

(B. S. and E. M., New Mexico School of Mines, 1909.)

Student, 1905-1909. From Louisville, Kentucky. Chemist, El Chino Copper Company, Santa Rita, New Mexico, 1909-1910; Mill superintendent, Germania Mining Company, Springdale, Washington, 1910; Chief sampler, Inspiration Copper Company, Globe, Arizona, 1910; Engineer, United States Steel Company, Depue, Illinois, 1911—.

JULIUS SANCHEZ

Entered, 1912, from Socorro, New Mexico. Freshman class.

MARGUERITO SANCHEZ

Entered, 1913, from Socorro, New Mexico. Special.

CHARLES L. SEARCY Monterey, Nuevo Leon, Mexico.

Student, 1903-1904. From Peoria, Illinois. Mining engineer, Monterey, Nuevo Leon, Mexico.

CONRADO SEDILLO

Entered, 1914, from Socorro, New Mexico. Special.

CHARLES S. SHAMEL Seattle, Washington.

(B. S., M. S., University of Illinois; LL. B., University of Michigan; A. M., Ph. D., Columbia University.)

Graduate student, 1901-1902. Mining lawyer, Seattle, Washington.

E. B. SMILEY

Entered, 1912, from Socorro, New Mexico. Special.

JAMES AVERY SMITH Miami, Arizona.

Entered, 1908, from Socorro, New Mexico. B. S. degree in Metallurgical Engineering, 1913; Assayer and sampler, Inspiration Copper Company, Miami, Arizona.

IRVING L. SMITH

Entered, 1913, from Socorro, New Mexico. Academic Department.

OLIVER RUSSELL SMITH Naches, Washington.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1908; C. E., New Mexico School of Mines, 1902.)

Graduate student, 1898-1901. From Manhattan, Kansas. B. S. in Civil Engneering, New Mexico School of Mines, 1902; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1901; Instructor in Engineering and Drawing, same, 1901-1902; Assistant professor in Engineering and Drawing, same, 1902-1903; Assistant surveyor, U. S. General Land Office, 1902; City engineer, Socorro, New Mexico, 1902; Deputy mineral surveyor, U. S. General Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1903-1907; Civil engineer, Santa Fe Railway, San Bernardino, California, 1907-1908; Engineer, United States Reclamation Services, Zillah, Washington, 1908-1910.

RICHARD STACKPOLE

Entered, 1914, from Socorro, New Mexico. Academic Department.

JACOB STAPLETON

Entered, 1912, from Socorro, New Mexico. Academic Department.

PAUL E. M. STEIN El Paso, Texas.

(B. S., New Mexico School of Mines, 1911; E. M. in Mining Geology, 1912.)

Student, 1907-1912. From Davenport, Iowa. Assistant engineer, Socorro Mines Company, Mogollon, New Mexico, 1912; Chemist, El Paso plant, Kansas City Consolidated Smelting and Mining Company, El Paso, Texas, 1912—.

WILLIAM CARLOS STEVENSON*

Student, 1900-1901. From Hillsboro, Ohio. General manager, Mining Corporation, Albuquerque, New Mexico, 1901.

*Deceased.

KARL AKSEL STRAND Bisbee, Arizona.

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1906-1912. From Socorro, New Mexico. Ore classifier, Utah Copper Company, Garfield, Utah, 1912; Draughtsman, same, 1912.

JOHN STUPPE Torreon, Coahuila, Mexico.

Student, 1903-1904. From El Paso, Texas. Accounting department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1904.

LEO RICHARD AUGUST SUPPAN St. Louis, Missouri.

(B. S. in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)

Student, 1895-1896. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-1897; Graduate student, John Hopkins University, Baltimore, Maryland, 1897-1898; Professor of Chemistry, Marine-Sims College, St. Louis, Missouri, 1898—.

MARGUERITE SWEET

Entered, 1913, from Socorro, New Mexico. Academic Department.

DONALD S. TEDFORD

Entered, 1913, from Berrysville, Arkansas. Special.

OTTO JOSEPH TUSCHKA Monterey, Nuevo Leon, Mexico.

(E. M. in Metallurgical Engineering, New Mexico School of Mines, 1897.)

Student, 1893-1897. From Socorro, New Mexico. Assayer and chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-1898; Graduate student, New Mexico School of Mines, 1898-1899; Assistant sampling mill foreman and chemist, Guggenheim Smelting & Refining Company, Monterey and Aguascalientes, Mexico, 1899-1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chief chemist, Compania Minera, Fundidora, y Afinadora "Monterey," Monterey, Nuevo Leon, Mexico, 1900—.

LAURENCE P. WELD Thompson, Nevada.

(B. S. and E. M., New Mexico School of Mines, 1912.)

Student, 1908-1912. From Rochester, New York. Concentrator man, Original Amador Mines Company, Amador City, California, 1912-1913; Assistant engineer and chemist, same company, 1913; Smelter electrician, Mason Valley Mines Company, Thompson, Nevada, 1913—.

MILTON BENHAM WESCOTT Monterey, Nuevo Leon, Mexico.

Student, 1904-1905. From Chicago, Illinois. Engineering corps, Santa Fe Railway, 1905; Assistant county surveyor, El Paso county, Texas, 1906-1907; Assistant engineer, Monterey Railway, Light and Power Company, Monterey, Nuevo Leon, Mexico, 1907; Assistant engineer, Monterey Water-works and Sewer Company, Monterey, Nuevo Leon, Mexico, 1907-1908; Resident engineer, same, 1908—.

PATRICK ANDREW WICKHAM Maris, Chihuahua, Mexico.

Student, 1893-1894. From Socorro, New Mexico. Mechanical engineer, Buckeye Mining Company and Albemarble Mining Company, Bland, New Mexico, 1898-1899; Mechanical engineer, Mt. Beauty Mining Company, Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Company, Cripple Creek, Colorado, 1900-1901; Foreman, Guggenheim Exploration Company, Minas Tecolotes, Santa Barbara, Chihuahua, Mexico, 1901-1902; Foreman, Independence Consolidated Gold Mining Company, Cripple Creek, Colorado, 1902-1904; Manager, Consuelo & Esperanza Gold Mining Companies, Dolores, Mexico, 1904-1906; Assistant superintendent, Kelvin-Calumet Copper Mining Company, Ray, Arizona, 1907-1908; Superintendent La Cienega Mining Company, Maris, Chihuahua, Mexico, 1909—.

WAKELEY A. WILLIAMS Grand Forks, British Columbia, Canada.

Student, 1893-1894. From Council Bluffs, Iowa. Assistant superintendent, Granby Consolidated Mining, Smelting, and Power Company, Limited, Grand Forks, British Columbia, Canada, 1898. At present superintendent of same.

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4-15.

ANNUAL REGISTER

OF THE

NEW MEXICO STATE SCHOOL OF MINES

SOCORRO, N. M.

1914-1915

With Announcements for 1915-1916

MAIN BUILDING

ANNUAL REGISTER

OF THE

NEW MEXICO STATE SCHOOL OF MINES

SOCORRO, N. M.

1914-1915

With Announcements for 1915-1916

UNION LABEL

ALBRIGHT & ANDERSON, PRINTERS-BINDERS, ALBUQUERQUE

CALENDAR.

1915.

First Semester:

September 20, Monday—Registration of students.

September 23, Tuesday—Class work begins.

November 25, Thursday—Thanksgiving.

December 23, Thursday, 4 P. M.—Holiday recess begins.

1916.

January 3, Monday—Work resumed.

January 25, 26, 27—Examinations.

Second Semester:

January 28, Friday—Second semester begins.

May 22, 23, 24—Final examinations.

May 25, Thursday, 8:30 P. M.—Commencement.

BOARD OF REGENTS.

His Excellency, William C. McDonald, *Governor of New Mexico, ex-officio*........................Santa Fe

Hon. Alvan N. White, *Superintendent of Public Instruction, ex-officio*........................Santa Fe

A. C. Torres................................Socorro

John McIntyre................................San Antonio

W. M. Borrowdale................................Magdalena

J. E. Smith................................Socorro

W. R. Morley................................Datil

OFFICERS OF THE BOARD.

A. C. Torres................................President

John McIntyre....................Secretary and Treasurer

Mrs. Blanche E. Reed....................Clerk of Board

FACULTY.

Fayette Alexander Jones........................*President*

C. E., E. M., State School of Mines, University of Missouri, 1892; Engineer, Union Mining Company, Phoenix, Ariz, 1893; Topographic Engineer for sewer system, Independence, Mo., 1894; Chief of topographic surveys, Isthmus of Tehuantepec, 1894-5; Mining Engineer, Phoenix, Ariz., 1896; U. S. Assayer at Kansas City, 1896-8; Chemist of Missouri State Geological Survey, 1897-8; President New Mexico School of Mines, 1898-02; LL. D., Nashville College of Law, Tenn., 1903; Field Assistant U. S. Geological Survey, 1901-6; Member New Mexico Board of Exposition Managers to International Exposition at St. Louis and chairman of Committee on Mines and Mining, 1903-4; Statistician of U. S. mint for precious metals of New Mexico, 1904-6; Geologist, Colorado, Columbus & Mexican Railway, 1908-9; Chief of expedition and mineralogist to Island Tiburon in Gulf of California, 1909; Mining Engineer, Grants Pass, Oregon, 1910-11; Chief of geological and mineralogical explorations through central British Columbia along proposed line of Grand Trunk Pacific Railway, 1911-12; re-elected President New Mexico State School of Mines, 1913—; Author, etc.

Thomas Calvin MacKay....*Professor of Physics, Mathematics*

A. B., Dalhousie University, 1893; Principal of Baddeck Academy, 1893-94; Principal of Parrsboro High School, 1894-96; Graduate student at Dalhousie University, 1896-98; A. M. at Dalhousie, 1898; A. M. at Harvard, 1899; Assistant in Physics at Harvard University, 1899-1900; Austin Teaching Fellow at Harvard, 1900-1901; Assistant at Harvard and Radcliffe, 1901-04; Ph. D. at Harvard, 1903; Instructor in Physics at the University of California, 1904-09; Demonstrator in Physics at Dalhousie University, 1909-10; Professor of Physics at Mt. Allison University, 1910-11; Professor of Physics and Mathematics at the New Mexico State School of Mines, 1911—; Author of a text-book on physical measurements and of various papers on physical subjects.

Gustavus Edwin Anderson..........................
....................*Professor of Geology and Mineralogy*

S. B. in Geology, University of Chicago, 1905; A. M., Columbia University, 1906; Instructor in Geology, Columbia University, 1905-06; University Fellow in Geology, Columbia University, 1906-07; Professor of Geology, Imperial Mining College, Wuchang, China, 1907-09; Geologist for the Han Yang Iron Works, Han Yang, China, 1908-09; Associate Professor of Geology, Pennsylvania State College, 1909-1911; in charge of field work on the Belle Fonte Quadrangle, State College, Pa., 1908-09; Professor of Geology and Mineralogy, New Mexico State School of Mines since 1911.

Viggo Emmanual Hanson......*Professor of Civil Engineering*

B. S., State University of South Dakota, 1910; on erecting floor, Blake Knowles Pump Works, East Cambridge, Mass., 1910-11; Draftsman, Blake Knowles Pump Works, East Cambridge, Mass., 1911-12; Assistant Professor of Civil Engineering, New Mexico State School of Mines, 1912-14; Professor of Civil and Mechanical Engineering, New Mexico State School of Mines, 1914—.

Elton L. Quinn.......................*Professor of Chemistry*

A. B., Bates College, Lewiston, Maine, 1910; Assistant instructor in chemistry, Princeton University, 1910-12; Junior chemist, U. S. Bureau of Mines, Pittsburgh, Pa., summer of 1912; Graduate Fellow, Princeton University, 1912-13, with Ph. D.; Research chemist on naval stores by-products for the Bagdad Land and Lumber Company, Bagdad, Florida, 1913-14; Head of Department of Chemistry, New Mexico State School of Mines, 1914—.

HOWARD STRIEF*.................................. ......Professor of Mining and Metallurgical Engineering

B. S. graduate in Mining Engineering, Case School of Applied Science, Cleveland, Ohio, 1903; Draughtsman, East Ohio Gas Company, 1904; aided in construction of and worked in cyanide mill, Deadwood, S. D., 1905; Teacher in Mechanical Drawing, Central Manual Training School, five years; between 1910-14 was engaged in various mining, metallurgical and engineering work for the Guggenheims and others, namely at Velardena, Durango, and Santa Eulalia, Chihuahua, Mexico; in charge of the interests of the City of Cleveland, Ohio, during construction of the Cleveland Short Line Railway; did the field engineering for the construction of blast furnace plant, embracing practice in re-inforced concrete, cable tramways and in conducting a general engineering business for the past two years in Cleveland, Ohio; Professor of Mining and Metallurgical Engineering, New Mexico State School of Mines, 1914—.

JOHN BUCHANAN GUNTER......Principal Academic Department

B. Pd., New Mexico Normal School at Silver City, 1911; Principal of Public School, San Marcial, N. M., 1911-1912; Instructor in New Mexico Normal School (summer sessions), 1911 and 1913; M. Pd., New Mexico Normal at Silver City, 1913; Superintendent of Public Schools at Belen, N. M., 1912-1914; Principal Academic Department, New Mexico State School of Mines, 1914—.

MANUEL A. SANCHEZ...................Instructor in Spanish

MRS. BLANCHE E. REED...............Registrar and Librarian

*Resigned. Resignation takes effect August 31, 1915.

NEW MEXICO
STATE SCHOOL OF MINES

HISTORICAL SKETCH.

The New Mexico State School of Mines was founded by Act of the Legislature of 1899. The Act provided for the support of the school by an annual tax of one-fifth of a mill on all taxable property.

Under an Act of the Legislature, approved February 28, 1891, a board of trustees was appointed. Organization was effected and immediate steps were taken towards the erection of necessary buildings. In the same year a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892 a circular of information regarding the New Mexico School of Mines at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims of the institution were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made to enable the School of Mines to be organized in accordance with the policy outlined by the Act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land fifty thousand acres for its support and maintenance. From this source of revenue the School has already received more than $20,000.

In 1899 the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901 the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grants of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903 the Thirty-fifth General Assembly raised the millage to forty-five one-hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

Since 1903 the appropriation for the support and maintenance of the School of Mines has been increased at each session of the General Assembly. At the first session of the State Legislature the appropriation was raised to $22,500 a year.

The Second State Legislature of the present year has just provided the additional fund of $20,000 for machinery and metallurgical equipment, which sum will be spent during the summer to carry out the purpose intended.

By the terms of the Enabling Act under which New Mexico was admitted to statehood, the School of Mines becomes possessed of an additional 150,000 acres of land. Most of this land has now been selected and will soon become the source of a very considerable revenue to the institution.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the Act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this Act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agricultural, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this Act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and

10 of this Act. Said trustees and their successors in office shall constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this Act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said School require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico State School of Mines is located at Socorro, the county seat of Socorro County, on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the valley of the Rio Grande at the foot of the Socorro range of mountains at an elevation of 4,600 feet above the level of the sea. The surrounding scenery is diversified by plains, valleys, mesas, hills, and mountains. The climate of the locality is pre-eminently pleasant and healthful, and has long attracted health-seekers who would escape the rigors of less favored localities. The air is exceedingly dry and the temperature is mild and equable. Socorro's public water supply comes from warm springs that issue from Socorro mountain three miles

away. The water is famed for its purity and has always been an attraction to visitors and residents.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools. Almost the entire geological column is here exposed.

The New Mexico State School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Deming, Fierro, Silver City, Pinos Altos, Santa Rita, Burro mountains, Los Cerrillos, Dawson, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, lixivation, cyaniding, and other metallurgical processes.

A number of mines of various kinds, smelters, irrigation systems, and other engineering works are accessible to the School. Within a few hours' ride by rail are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the oldest worked lodes in America are in this region. Gold and turquoise were first noted by the conquistadores in 1540-2 by the celebrated expedition of Francisco Vasquez de Coronado, when in search of the Gran Quivira, one of the seven cities of Cibola. The first modern discovery of gold in New Mexico was made at the base of the Ortiz mountains, in Santa Fe county, in the year 1828. The first copper mined west of the Mississippi river was at Santa Rita in Grant county, in 1800. The metal from these copper mines was transported on the backs of burros to Mexico City and thence sent to the royal mint of Spain to be made into coin. The Chino Copper Company now operates these celebrated mines. Among the great wonders of the West are the

ancient turquoise working at Mount Chalchihuitl near Los Cerrillos. An ancient lode mine, known as Mina del Tierra, is situated near the ancient turquoise workings. Verily, New Mexico is the birthplace of American mining.

The history of modern mining schools shows that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico State School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of the world.

The School is a state institution. It was established primarily to promote the development of the mineral resources of New Mexico and to provide facilities for the young men of the state to secure a practical education in all departments of mining. Naturally, however, the institution's field of usefulness has steadily grown broader. Not only New Mexico but also other parts of the southwest have felt its influence through its graduates in the development of the mining industries of this great region. Moreover, a considerable number of students from other parts of the country who desired to avail themselves of the peculiar advantages of this region have come to the School of Mines for the training they needed and the number of such young men is constantly increasing.

During the entire period of his training the fact is impressed upon the mind of the student that intelligent mining is a business operation capable of being put on as secure a foundation as any other; that from beginning to end it is akin to all other great business undertakings. While lucky finds will doubtless continue to be made, mining is no longer to be considered a mere lottery appealing to the gambling propensities.

During the past quarter of a century the development of the mineral wealth of the nation has been phenomenal and the calls

for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines:

The unique natural surroundings of the School already described create an invigorating mining atmosphere which is entirely wanting in institutions remote from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversious that necessarily exist in those technical institutions of learning where all practical branches are equally represented, singleness of purpose is a leading feature of the New Mexico State School of Mines. The conservation of energy growing out of the special method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect, under the direct supervision of his instructors, various plants and works and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work and at once necessarily acquires for his chosen profession a sympathy that is seldom attained, except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portions, which comprise about two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the state has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made under

government auspices to investigate closely the geological structure of New Mexico mountains such as have been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

Much of the advanced professional work of the School is of an original nature to the end that the graduates may be skilled, theoretically and practically, in the very problems which they as professional men will be called upon to solve. This work is carried on by the advanced students under the direction of the professors and involves the collection of notes, sketches, maps, and specimens, and the results of directed observations in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining and in the reduction of the ores of lead, silver, gold, copper, and zinc are so numerous that it is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply, and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, thus giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigators of the ores of iron, manganese, aluminum, cobalt, nickel, tin, and quicksilver, vanadium, and uranium, together with the beds of coal, salt, alum, building stones, mineral-paints, cement-rocks, marls, etc., are directly in line with the advanced laboratory work of the School, and every student who undertakes such work is encouraged in every possible way to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico State School of Mines is vested in a Board of Regents consisting of five members appointed by the Governor of the State with the concurrence of the Senate for a term of four years. The Board of Regents elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them, as well as the selecting of a teaching staff.

By Act of the Legislature, the maintenance of a preparatory

department is required of the higher educational institutions of the state. The New Mexico State School of Mines, therefore, is composed of the College and the Academy.

THE COLLEGE.

Requirements for Admission.

Candidates for admission to the College are required to present a statement from some school of recognized standing certifying that they have completed and received a passing grade in the following subjects: Elementary Algebra, Plane and Solid Geometry, Physical Geography, ninth, tenth and eleventh grade English, and one year of Elementary Physics and Geology. Those candidates who are unable to present such a statement may take an examination by the Principal of the Academy on any of the foregoing subjects to determine their proficiency therein.

Registration.

No student will be allowed to register for any subject until the pre-requisites are credited to him on the school records. Therefore the student is advised not to delay either in making up any deficiencies which may exist or in obtaining from the School the credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the Bachelor's Degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time of matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions.

Every candidate for admission to the School may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students desiring to take special courses without a view to graduation may do so provided that they give evidence of proficiency in the prerequisite subjects and that their taking such courses does not interfere with the regular schedule of classes.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

Curricula.

MINING ENGINEERING.

METALLURGICAL ENGINEERING.

GEOLOGICAL ENGINEERING.

CIVIL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of either of them the Bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines who have spent two years in professional work, at least one of which must have been in a position of responsibility, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours' work in the field or in the laboratory. In the following outlined statement of curricula the number of hours per week required in the class-room and in the field or in the laboratory are given separately. The number of hours required in the field or in the laboratory represents *average* time, however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

Short Courses.

For the benefit of resident young men of the state short courses of a few weeks duration will be given in prospecting, assay-

ing, mineralogy, surveying, chemistry, mechanics, electricity, etc. Such a departure from the full college courses ought appeal to those who wish to attain greater efficiency, which will mean a corresponding increase in wages.

UNIFORM CURRICULUM FOR THE FIRST TWO YEARS.

The curriculum for the first and second years of the four courses offered at the School of Mines is the same in all respects. This arrangement is of advantage to the student, as it gives him until the beginning of the third year to determine for which of the four courses he is best fitted by inclination or aptitude.

Mathematics, physics, and chemistry are fundamental subjects for the successful engineer. For that reason the two first years of all the engineering courses are devoted to a thorough grounding in those three subjects as will be seen in the tabular statement below. Specialization does not begin until afterwards.

Excellent facilities are offered for the acquisition of a thorough knowledge of these subjects so necessary to successful engineering work both during the remainder of the course and during a professional career.

UNIFORM CURRICULUM.

FIRST YEAR.

Course Numbers		Courses.	Hours per Week	
			Class	Lab'y
		First Semester.		
I.	1.	Algebra	5	
I.	2.	Trigonometry (Plane)	5	
I.	3.	Analytic Geometry	2	
III.	1.	General Chemistry	3	6
IV.	15.	Shop		6
IV.	17.	Mechanical Drawing		6
		Second Semester.		
I.	1.	Advanced Algebra	3	
I.	2.	Trigonometry (Spherical)	1	
I.	3.	Analytic Geometry	4	
III.	1.	General Chemistry	3	6
IV.	1.	General Surveying	3	4
IV.	18.	Machine Drawing		6
IV.	20.	Descriptive Geometry	2	
IV.	16.	Machine Shop		6

UNIFORM CURRICULUM.

SECOND YEAR.

Course Numbers		Courses.	Hours per Week	
			Class	Lab'y
		First Semester.		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	2.	Qualitative Analysis	1	9
VI.	10.	Mine Surveying and Mapping (1st Half)	2	8
IV.	2.	Railroad Surveying (2nd Half)........	2	4
V.	1.	Mineralogy	3	3
V.	2.	General Geology	2	
		Second Semester.		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	3.	Quantitative Analysis	1	6
IV.	3.	Topographical Surveying...............	2	4
V.	1.	Mineralogy	3	3
V.	3.	General Geology	3	
II.	3.	Electricity and Magnetism	2	3

MINING ENGINEERING.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valuing property, properly reporting propositions submitted for investment, calculating the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaption of the steam shovel and stripping methods to western metal mines are treated at considerable length.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives detailed consideration.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers		Courses.	Hours per Week Class	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	5.	Ore Analysis	1	9
IV.	6.	Strength of Materials	3	
V.	7.	Petrology	2	3
VI.	1.	Mining A.	3	3
VII.	2.	General Metallurgy	3	2
II.	7.	Thermo-dynamics	2	
		Second Semester.		
II.	4.	Mechanics	4	
IV.	6.	Strength of Materials	3	
V.	4.	Field Geology	1	8
V.	7.	Petrology	2	3
III.	6.	Fuel Analysis		3
VI.	2.	Mining B.	3	
VII.	1.	Fire Assaying	1	8
IV.	19.	Machine Design	2	6
IV.	21.	Boilers	3	

FOURTH YEAR.

Course Numbers		Courses.	Hours per Week Class	Lab'y
		First Semester.		
V.	5.	Economic Geology	3	
V.	4.	Mine Economics	3	
V.	6.	Ore Dressing	3	6
VI.	9.	Design of Mine Plant		3
VII.	5.	Metallurgy of Copper	2	3
IV.	23.	Hydraulics	3	
IV.		Engines	3	
		Second Semester.		
V.	5.	Economic Geology	3	
IV.	23.	Air Compression and Pumping	3	
VI.	6.	Ore Dressing	2	3
VI.	9.	Design of Mine Plant		6
VI.	7.	Mine Administration and Accounts	2	
'8	'IA	Examination of Mines	1	3

METALLURGICAL ENGINEERING.

The aim of this four years course is to train the student for a professional career in any branch of metallurgical work. Attention is given during the first two years to such fundamental subjects as mathematics, chemistry, physics, geology, mineralogy and preliminary courses in engineering. Instruction in metallurgy proper begins in the third year, both lectures and laboratory experiments being employed for the purpose. Chemistry and geology are provided for, also. The work of the fourth year is along the line of advanced courses in metallurgy; especial attention being given to laboratory experiments, high temperature conditions of metallurgy, training in execution, and interpretation of results. Such higher branches of engineering, chemistry, and courses of importance in mining engineering claim a considerable share of attention.

The course has been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers		Courses.	Hours per Week	
			Class	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	5.	Ore Analysis	1	9
IV.	6.	Strength of Materials	3	
V.	7.	Petrology	2	3
V.	1.	Mining A.	3	
VII.	3.	Principles of Metallurgy	3	2
II.	7.	Thermo-dynamics	2	
		Second Semester.		
II.	4.	Mechanics	4	
IV.	6.	Strength of Materials	3	
V.	7.	Petrology	2	3
III.	6.	Fuel Analysis		3
VII.	1.	Fire Assaying	1	3
VII.	7.	Metallurgy of Iron and Steel	3	
IV.	19.	Machine Design	2	6
IV.	21.	Boilers	3	

FOURTH YEAR.

Course Numbers		Courses.	Hours per Week Class	Lab'y
		First Semester.		
VI.	6.	Ore Dressing	3	2
VII.	6.	Metallurgy of Gold and Silver..........	3	3
VII.	5.	Metallurgy of Copper	2	3
VII.	9.	Metallurgical Plant and Design........	1	3
IV.	23.	Hydraulics	3	
IV.		Engines	3	
		Second Semester.		
VI.	6.	Ore Dressing	2	2
VI.	7.	Mine Administration and Accounts......	2	
VII.	4.	Metallurgy of Lead and Zinc...........	3	
VII.	8.	Furnaces	3	
VII.	9.	Metallurgical Design		6
VII.	10.	Metallurgical Laboratory	1	8

GEOLOGICAL ENGINEERING.

This course extending over a period of four years is intended primarily to train men to examine, report and direct the future development of mines. In the first two years the course prescribed is similar to that of the Mining Engineering Department, so that students have a thorough training in fundamental subjects, especially in mathematics, chemistry, surveying, and other preliminary courses in engineering. In the second and third years the attention of the student is directed largely to geological subjects related closely to mining, namely, topographical surveying, geological surveying, petrology, and economic geology, while still continuing his studies in chemistry, mining, metallurgy, etc. The fourth year is devoted largely to advanced work in mining geology, visiting and reporting in detail on geological problems connected with ore deposition in various mining fields. Attention also is paid to the geological occurrence of petroleum.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers		Courses.	Hours per Week Class	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
III.	5.	Ore Analysis	1	9
IV.	6.	Strength of Materials	3	
V.	7.	Petrology	2	6
VI.	1.	Mining A.	3	3
VII.	2.	General Metallurgy	3	2
III.	10.	Physical Chemistry	2	
		Second Semester.		
II.	4.	Mechanics	4	
IV.	6.	Strength of Materials	3	
V.	7.	Petrology	2	6
VI.	2.	Mining B.	3	
VII.	7.	Metallurgy of Iron and Steel	3	
VII.	1.	Assaying	1	8
V.	4.	Field Geology	1	8

FOURTH YEAR.

Course Numbers.		Courses.	Hours per Week Class	Lab'y
		First Semester.		
V.	5.	Economic Geology	3	3
V.	9.	Ore Genesis		6
VI.	4.	Mine Economics	3	
VI.	6.	Ore Dressing	3	
VI.	9.	Design of Mine Plant		3
VIII.	5.	Metallurgy of Copper	2	
IV.	22.	Hydraulics	3	
VII.	6.	Metallurgy of Gold and Silver	3	
		Second Semester.		
V.	6.	Economic Geology	3	3
V.	8.	Geological Examination and Surveys	2	
V.	10.	Paleontology	2	6
VII.	4.	Metallurgy of Lead and Zinc	3	
V.	11.	Special Problems		5
IV.	23.	Air Compression and Pumping	3	
VI.	7.	Mine Administration and Accounts	2	
VI.	8.	Examination of Mines	1	3
VI.	9.	Design of Mine Plant		6

CIVIL ENGINEERING.

This department provides a course of study in the theory and application of the principles of civil engineering. The first two years of work are the same as in the other engineering courses, including practical work in drafting room and field, as well as instruction in the fundamental principles of mathematics and physics. In the third year the studies relate more directly to civil engineering. Technical courses cover the principles of structural and machine design, power and power transmission, and other fundamental engineering processes. In the drafting room the student applies those principles to the design of machines, and bridge and roof trusses. Sufficient field work is given to make the student thoroughly familiar with surveying instruments, and their use in road, mine, and railroad surveys. The proper care and adjustment of surveying and engineering instruments are made prominent in the training of the civil engineer.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers.		Courses.	Hours per Week	
			Class	Lab'y
		First Semester.		
II.	4.	Mechanics	4	
IV.	4.	Heating and Ventilation	3	3
IV.	5.	Roads and Pavements	3	
V.	7.	Petrology	2	3
IV.	22.	Elective	3	
IV.	6.	Strength of Materials	3	
II.	7.	Thermodynamics	2	
		Second Semester.		
II.	4.	Mechanics	4	
III.	4.	Engineering Analysis	1	6
IV.	6.	Strength of Materials	3	
IV.	7.	Graphics	2	3
V.	7.	Petrology	2	3
IV.	19.	Machine Design	2	6
IV.	21.	Boilers	3	

FOURTH YEAR.

Course Numbers	Courses.	Hours per Week Class	Lab'y
	First Semester.		
IV. 9.	Stresses	3	
IV. 10.	Structural Details		9
IV. 11.	Water Supply Engineering	5	
IV. 12.	Masonry	5	
IV. 22.	Hydraulics	3	
IV. 21.	Engines	3	
	Second Semester.		
III. 6, 7.	Water and Fuel Analysis		6
IV. 8.	Irrigation and Drainage	3	
IV. 9.	Stresses	3	
IV. 10.	Structural Details		9
IV. 13.	Sanitary Engineering	3	
IV. 14.	Concrete Structures	3	
IV. 24.	Contracts and Specifications	2	
IV. 28.	Air Compression and Pumping	3	

CLASS SCHEDULE FIRST SEMESTER.

HOUR	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8–9	Algebra Roads & Pavmts.	Anal. Geom. Mine Surv.	Algebra Roads & Pavmts.	Anal. Geom. Mine Surv.	Algebra Roads & Pavmts.	Mine & R. R. Surveying
9–10	Trigonometry Calculus Metallurgy Hydraulics	Trigonometry Calculus Physical Chem. Met. of Copper	Trigonometry Calculus Metallurgy Hydraulics	Trigonometry Calculus Physical Chem. Met. of Copper	Trigonometry Calculus Metallurgy Hydraulics	Mine & R. R. Surveying
10–11	Mineralogy Mechanics Engines	Geology Mechanics Met. Gold & Sil.	Mineralogy Thermodynamics Engines	Geology Mechanics Met. Gold & Sil.	Mineralogy Mechanics Engines	Mine & R. R. Surveying Thermodynamics
11–12	Chemistry Exp. Mechanics Mining A Heating & Vent. Economic Geol.	Algebra Qual. Analysis Petrology Stresses Mine Economics	Chemistry Exp. Mechanics Mining A Heating & Vent. Economic Geol.	Algebra Petrology Stresses Mine Economics	Chemistry Exp. Mechanics Mining A Heating & Vent. Economic Geol.	Mine & R. R. Surveying Mine Economics
P. M. 1–2	Spanish	Spanish	Spanish	Spanish	Spanish	Mine & R. R. Surveying
2–3	Stresses					Mine & R. R. Surveying
2–5	General Chem. Qual. Analysis Ore Analysis	Drawing Phys. Lab. Petrology Water & F. An.	General Chem. Qual. Analysis Ore Analysis Struct. Details	Drawing Mineralogy Water & F. An.	Shop Qual. Analysis Ore Analysis Struct. Details	Mine & R. R. Surveying

CLASS SCHEDULE SECOND SEMESTER.

HOUR	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8–9	Spher. Trig. Air Compression & Pumping	Anal. Geom. Topo. Survey'g	Anal. Geom. Air Compression & Pumping	Anal. Geom. Topo. Survey'g	Anal. Geom. Air Compression & Pumping	Surveying Field Geol. Fire Assaying
9–10	Gen. Surveying Calculus Met. Iron & Steel Econom. Geol.	Desc. Geom. Calculus Fire Assaying	Gen. Surveying Calculus Met. Iron & Steel Econom. Geol.	Desc. Geom. Calculus Exam. of Mines	Gen. Surveying Calculus Met. Iron & Steel Econom. Geol.	Surveying Field Geol. Fire Assaying
10–11	Algebra Geology Boilers Ore Dressing	Water Sup. Eng. Mineralogy Mechanics Met. of Zinc & Lead	Algebra Geology Boilers Ore Dressing	Water Sup. Eng. Mineralogy Mechanics Met. of Zinc & Lead	Algebra Geology Boilers Ore Dressing	Surveying Field Geol. Fire Assaying Mechanics
11–12	Gen. Chemistry Physics Mining B Geol. Surveying Water Sup. Eng.	Electricity and Magnetism Petrology Mine Administrat'n & Accts. Conts. & Spec.	Gen. Chemistry Physics Mining B Geol. Surveying Water Sup. Eng.	Electricity and Magnetism Petrology Mine Administrat'n & Accts. Conts. & Spec.	Gen. Chemistry Physics Mining B Field Geology	Surveying Field Geol. Fire Assaying
P. M. 1–2	Spanish Furnaces	Spanish	Spanish Furnaces	Spanish	Spanish Furnaces	Surveying Field Geol. Fire Assaying
2–5	Gen. Chemistry Heat & Light	Shop Electricity and Magnetism Met. Design	Gen. Chemistry Quant. Analysis Petrology Eng'ng Analysis	Shop Mach. Drawing Mineralogy Met. Design Machine Design Struct. Design	Mach. Drawing Quant. Analysis Fuel Analysis Eng'ng Analysis	Surveying Field Geol. Fire Assaying

DEPARTMENTS OF INSTRUCTION

I. DEPARTMENT OF MATHEMATICS

DOCTOR MACKAY.

The study of mathematics is emphasized as a necessary basis for the further instruction in the engineering subjects. The courses have been arranged to meet the extensive needs of students in the various branches of engineering and are intended to develop power of deduction as well as to familiarize the student with the various methods of calculation used in practical problems. Students are encouraged to use logarithms and the slide rule when the latter can be employed without too great loss of accuracy. They will also be introduced to the books of tables that facilitate calculation.

1. Advanced Algebra.

The work begins with a review of elementary algebra. This is followed by the solution of simple and quadratic equations with a large number of practical problems, the summation of arithmetical and geometrical progressions, graphical solutions of equations, vector quantities, variation and proportion, partial fractions, logarithms, inequalities, probabilities, abridged methods of calculation, slide rule, and limits of error.

Prerequisite: *Elementary Algebra.*

Time: Class room, five hours a week, first semester; three hours a week, semond semester.

Text: Hawkes, *Advanced Algebra.*

2. Trigonometry.

A thorough knowledge of the subject matter of this course is essential for the successful carrying out of general surveying, topographic surveying, and mine surveying. It deals with the measurement of angles; the relations among the sine, cosine, and tangent of an angle; the values of the functions of multiple and fractional angles; solution of simple trigonometric equations; the solution of right and oblique triangles, involving logarithmic calculations with tables and very many practical problems; the simplest elements of spherical trigonometry. The last men-

tioned subject is necessary for an understanding of the methods of determining latitude and longitude, and also is essential for geodetic surveying.

Prerequisites: Elementary Algebra and Plane and Solid Geometry.

Time: Class-room, five hours a week, first semester; one hour a week, second semester.

Text: Murray, *Plane and Spherical Trigonometry with Tables.*

3. Analytic Geometry.

This subject combines the methods used in algebra and in geometry, and employs them in the study of simple curves, surfaces, and solids. It therefore affords a very good introduction to mechanical drawing, mapping, surveying, and mensuration. It deals with plotting with different systems of co-ordinates, estimation of areas, properties of systems of straight lines, circles, the parabola, the ellipse, the hyperbola, changes produced in maps by change of origin and rotation of axes, simple curves in three dimensions, surface areas and volumes of simple solids.

Prerequisites: Courses 1 and 2 of this department must accompany or precede this course.

Time: Class-room, two hours a week, first semester; four hours a week, second semester.

Text: Smith and Gale, *New Analytic Geometry.*

4. Differential Calculus.

This subject is of great importance in the study of curves, of rates of variation, of maximum and minimum values; and is indispensable for the reading of most text-books of science, especially as applied in text-books on engineering. It includes limits, curve tracing and other applications of the derivative, maxima and minima, radii of curvature, summation of series, partial differentiation, and the solution of many problems in least cost and maximum efficiency.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, five hours a week, first semester.

Text: Murray, *Differential and Integral Calculus.*

5. Integral Calculus.

The integral calculus is the most powerful weapon of calculation. It is applied in this course to the calculation of lengths of curves, areas of surfaces, volumes of solids, moments of inertia, centers of gravity, work performed by bodies moving against given forces, and in many other applications to mechanics, heat, electricity and magnetism, and mensuration.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Time: Class-room, five hours a week, second semester.

Text: Murray, *Differential and Integral Calculus.*

SPECIAL AND GRADUATE COURSES IN MATHEMATICS.

Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work. The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in mathematical investigation of problems of engineering or applied science. The idea that an engineer should be a practical rather than a theoretical mathematician has guided the selection of elective and graduate courses. Students who wish to take optional work should arrange at the beginning of the college year with the head of the department of mathematics.

In addition to the foregoing, which are required of all students of engineering, the following elective and graduate courses are offered:

6. Integrals of Mechanics.

Certain types of integrals which are met with great frequency in the study of mechanics, are treated. These integrals, namely, the inertia integrals, those defining mass, and moment and center of mass, are essential in the discussion of the motion and the conditions of equilibrium of systems of particles and rigid bodies. Other integrals are studied, involving applications of mechanics to work, attraction, pressure, and centers of gravity and pressure.

Text: Lester, *The Integrals of Mechanics.*

7. Applications of the Calculus to Mechanics.

Wherever the teaching of mathematics to engineering students is discussed, and frequently in cases of other classes of students, the criticism which is almost without exception the most insist-

ent is this: that the student leaves the course without adequate ability to *apply* his mathematical knowledge. This means that he has not the faculty of taking a problem, giving it an analytic formulation, and interpreting the analytic results. This course is intended to supply the needed training. Students should obtain a comprehensive view of this course, partly because of the value of such a course as a means of general mental development, partly because new practical applications of discoveries in engineering are continually being made, and because no one can predict what particular facts or principles are most likely to find important practical applications in the future.

Text: Hedrick & Kellogg, *Applications of the Calculus to Mechanics.*

8. Differential Equations.

In many Colleges of Engineering, the need is felt for a course treating the subject of Differential Equations, limited in scope, yet comprehensive enough to furnish the student of engineering with sufficient information to enable him to deal intelligently with any differential equation which he is likely to encounter. To meet this need is the object of this course. Numerous applications to problems in Geometry, Physical Sciences, and Engineering are introduced.

Text: Cohen, *An Elementary Treatise on Differential Equations.*

II. DEPARTMENT OF PHYSICS

Doctor MacKay.

The courses in physics outlined below serve to introduce students to accurate measurements identical with or similar to those which he will have to perform frequently as an engineer. In general, the experiments carried out in these courses help him to understand the physical bases for the varied methods of procedure in engineering processes. The apparatus for the course in experimental mechanics is of a very substantial character. This apparatus is well adapted for illustrating principles that lie at the foundation of an engineer's work. As in the other courses in this department, the laboratory work is accompanied by lecture room discussions and by the working out of illustrative problems. The course in heat forms an introduction to metallurgical processes especially. The course in light is introductory to much of the succeeding work in mineralogy and petrography. The elementary course in electricity and magnetism is devised for students of all branches of engineering, especial attention being paid to electrolysis and to the methods of action of simple electrical machines. The student is here introduced to the measurement and calculation of the principal electrical quantities that are met with in common engineering practice. The succeeding courses in electricity and magnetism are intended to give an opportunity for a deeper study of these subjects, and are intended especially for students who wish to specialize in electrical engineering, or in electrical machinery for mine plants, etc.

1. Experimental Mechanics.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly accelerated motion; (2) Relation of force to mass and

to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Expansion of gases; (14) Archimedes' principle; and a few other exercises if time permits.

Prerequisites: Course 2 of Department 1.

Time: Class-room, three hours a week, first semester.
Laboratory, three hours a week, first semester.

Text: Millikan, *Mechanics, Molecular Physics and Heat.*
Duff, *A Text Book of Physics.*

2. Heat and Light.

The first part of this course will deal with temperature, expansion, thermal conductivity, radiation, convection, change of state, the calorimetry, with simple applications to furnaces, ventilation, and heat engines. The second part of the course will deal with the laws of reflection and refraction of light, combinations of lenses, eye-pieces and objectives of microscopes, prisms, double refraction, the spectrometer, polarized light and photometry.

Prerequisites: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Text: Duff, *A Text Book of Physics.*
Millikan and Mills, *Electricity, Sound and Light.*
Millikan, *Molecular Physics and Heat.*

3. Electricity and Magnetism.

This course deals with the elementary principles of electricity, magnetism, and the practical application of the same to dynamos, motors, lamps and electric furnaces. Qualitative experiments are performed in the lecture-room to illustrate the principal phenomena of this very large and fruitful subject. Quantitative experiments are performed in the laboratory in order to make the electrical and magnetic quantities as much as possible real quantities in the experience of the student.

Prerequisite: Course 1 of this department must precede or accompany.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Text: Duff, *A Text Book of Physics.*
Silvanus Thompson, *Elementary Lessons in Electricity and Magnetism.*
Millikan and Mills, *Electricity, Sound and Light.*

4. Mechanics.

The principal topics taken up are force, combinations of forces, center of gravity, moment of inertia, gravitation, stress, numerous cases of equilibrium, cords, jointed frames, friction, velocity and acceleration, harmonic motion, translation, rotation, work, energy, impulse, momentum, and very many simple practical problems with different forms of structures and machines.

Prerequisites: Courses 2, 3, 4, and 5 of Department I and Course 1 of this department.

Time: Class-room, four hours a week, one year.

Text: Maurer, *Technical Mechanics.*
Sanborn, *Mechanics Problems.*

5. Electromagnetism.

A discussion of the fundamental equations of electricity and magnetism; and calculation of field intensities, resistances, capacities, self and mutual induction, etc.

Prerequisites: Courses 4 and 5 of Department I and Course 3 of this department.

Time: Class-room, three hours a week, first semester.

Text: Poynting and Thomson, *Electricity and Magnetism.*

6. Alternating Current Measurements.

Measurements of magnetic permeability of various kinds of iron and steel, induction of coils, capacities, efficiency of dynamos and motors, efficiency of transformers, etc. The principal types of alternating dynamos and motors will be studied, as well as the applications of alternating currents to electric lighting and to power transmission.

Prerequisites: Courses 1 and 3 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, six hours a week, second semester.

Text: Pender, *Elements of Electrical Engineering.*

7. Thermodynamics.

The application of the laws of heat and mechanics to the steam engine, internal combustion engines, refrigerators, compression and pumping machinery.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: To be announced at beginning of term.

III. DEPARTMENT OF CHEMISTRY

Doctor Quinn.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

1. Elements of Chemistry.

This course is introductory to the engineering courses and is required of all students. It comprises three lectures and two laboratory periods per week. The fundamental principles of the science are taught in connection with the descriptive chemistry of the various elements. The lectures are designed to precede the work of the laboratory, in which the student is expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking are required of each student.

No previous study of chemistry is required for admission to this course, but the instruction is so arranged that students who have already spent considerable time upon chemical work in secondary schools are admitted to lectures and laboratory work of a somewhat advanced character, in which the knowledge which they have already acquired is utilized.

Time: Class-room, three hours a week, first and second semester.
Laboratory, six hours a week, first and second semester.

Text: Smith, *General Chemistry for Colleges.*
Smith, *A Laboratory Outline of General Chemistry.*

2. Qualitative Analysis.

This course includes class-room instruction (one hour per week), laboratory practice, and individual conference with in-

structors in the laboratory. The student is required to analyze alloys, minerals, rocks, pigments, slags, mattes, and industrial products of various sorts and complexity. An effort is made to avoid mere thoughtless, mechanical laboratory work on the part of the student, and to give him an insight into the chemical principles involved in the processes studied.

This course is required of all students.

Prerequisite: Course 1 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, nine hours a week, first semester.

Text: Treadwell & Hall, *Analytical Chemistry*, Vol. I.
Baskerville & Curtman, *Qualitative Analysis*.

3. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

The gravimetric determination of chlorine in a soluble chloride; water of crystallization in copper sulphate; iron and sulphur in ferrous or ferric sulphate; carbon dioxide; calcium, and magnesium in dolomite; silver and copper in a dime; tin, lead, copper, and zinc in a bronze; and silica in an insoluble silicate.

The class-room work consists of lectures and quizzes in which the various analytical processes are studied from the standpoint of modern chemical theories. Required of all students.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, second semester.

Texts: Treadwell & Hall, *Analytical Chemistry*, Vol. II.
Olsen, *Quantitative Chemical Analysis*.

4. Engineering Analysis.

The course includes some of the more important determinations in gavimetric, volumetric, and electro analysis and is planned to give the engineer a general idea of quantitative analysis.

The following are some of the determinations which will be studied: Gravimetric determination of chlorine, iron, alumina, calcium, and magnesium; approximate analysis of coals; analysis of lubricating oils; heat value of coals and oils; volumetric

determination of the hardness of water; the per cent purity of soda and lime; the electrolytic determination of silver and copper in a dime; analysis of iron and steel.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, second semester.

5. Ore Analysis.

A thoroughly practical course in the determining of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products.

Each student is required to analyze two or more ores for each of the following: Iron, copper, zinc, lead, phosphorus, calcium, manganese, silica, sulphur, and arsenic. After this he will be required to accurately complete from ten to thirty determinations for any of the foregoing ores in one half day, thereby gaining a little of the speed and accuracy necessary to every practical assayer.

Prerequisite: Course 3 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, nine hours a week, first semester.

Text: Low, *Technical Methods of Ore Analysis.*

6. Fuel Analysis.

Analysis of various coals and other fuels are made, their heat values calculated from these analyses and also determined by means of a calorimeter. Flue gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.

Time: Laboratory, three hours a week, second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

7. Water Analysis.

Analyses of water are made in regard to their possible use in boilers. These analyses involve determination of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 3 of this department.

Time: Laboratory, second semester.

Texts: Stilman, *Engineering Chemistry.*
Treadwell & Hall, *Analytical Chemistry*, Vol. II.

8. Advanced Quantitative Analysis (Special).

This course is the extension of Course 3 or 4, and the work will be chosen to suit the needs of each student. It may consist of the complete analysis of rocks and minerals, advanced ore analysis, iron and steel analysis, cement analysis, or the determination of some of the rare elements.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, one semester.

9. Electro-Analysis (Special).

This course will deal with the practical application of the electric current in determining some of the common metals such as copper, silver, lead, and zinc. After the student has become familiar with the methods used for determining each of these, he will use the current in separating mixtures of metals and as a rapid, accurate method of ore analysis.

Prerequisite: Course 3 of this department.

Time: Laboratory, three hours a week, one semester.

Text: Edgar F. Smith, *Electro Analysis.*

10. Physical and Theoretical Chemistry.

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisite: Course 3 of this department.

Time: Class-room, two hours a week, first semester.
Text: Walker, *Introduction to Physical Chemistry.*

11. Inorganic Preparations (Special).

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 2 of this department.
Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week, one semester.

12. Industrial Inorganic Chemistry (Special).

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one semester.
Text: Rogers & Aubert, *Industrial Chemistry.*

13. Organic Chemistry (Special).

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

14. Elements of Practical Photography (Special).

The course is planned to furnish the engineer with a working knowledge of photography such as will enable him to use the camera intelligently as an aid in his engineering work.

The class-room work will consist of one lecture a week which will be supplemented by laboratory work in which each student will be required to take and finish a good negative, velox print, platinum print, lantern slide, and bromide enlargement.

Time: Class-room, one hour a week, second semester.

IV. DEPARTMENT OF CIVIL ENGINEERING

PROFESSOR HANSON.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the work of the fourth year the student is given instruction in Structural, Sanitary, and Hydraulic Engineering. The work, which is largely drawing and design, covers practical problems, with the intent that the student may become thoroughly familiar with the principles governing his profession and with their application.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies.

1. General Surveying.

The introductory course in surveying deals with the principles of land measurement, and with the instruments used in both field and office.

In the class-room, the adjustments of the level and transit are taught, and the uses of these instruments in land surveying illustrated by practical problems.

In the field practice, each student becomes familiar with the

use of the chain, tape, level, transit, etc.

Prerequisite: Course 2 of Department I.

Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.

Text: Breed & Hosmer, *Theory and Practice of Surveying.*

2. Railroad Surveying.

The work consists of field, recitations and drafting room practice.

The course is devoted to the mathematics of railroad curves together with the methods of staking out curves and computing earthwork.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, half the first semester.
Field work, four hours a week, half the first semester.

Text: Allen, *Railway Curves.*

3. Topographical Surveying.

The theory and use of the stadia and other instruments used in making a topographic survey are considered, as are also the methods of topographic surveying. Some time is given to topographic drawing. A complete topographic survey based on a system of triangulation is executed, including the calculations, and platting and completing the map. Some attention is given to the precise measurement of bases and angles.

Prerequisites: Course 1 of this department.

Time: Class-room, two hours a week, second semester.
Field, fours a week, second semester.

Text: Breed & Hosmer, *Higher Surveying.*

4. Heating and Ventilating.

The theory and principles of the different systems of heating buildings by steam, hot air, hot water or combinations of these systems. Calculations are made of the amounts of radiating surface required for each system and the auxiliary apparatus used with each. This is followed by a study of the different systems of ventilating.

Prerequisites:

Time: Class-room, three hours a week.

Text: Carpenter, *Heating and Ventilating.*

5. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways; location, construction, drainage, improvement and maintenance of country roads; various paving materials—broken stone, brick, asphalt, wood and stone blocks, and concrete; foundations for and adaptability of each; arrangement and details of city streets.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, first semester.

Text: Baker, *Roads and Pavements.*

6. Strength of Materials.

A study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to torsion, to compression, and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moment, slopes, and deflection; overhanging, fixed, and continuous beams, flat plates, and stresses in columns and in beams subjected to tension and compression as well as bending; torsioual stresses; and stresses in spring.

Prerequisite: Course 4 of Department II must accompany or precede.

Time: Class-room, five hours, second semester.

Text: Church, *Mechanics of Engineering.*

7. Graphic Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 4 of Department II.

Time: Class-room, two hours a week, second semester.

Text: Sondericker, *Graphic Statics.*

8. Irrigation and Drainage.

A series of lectures treating of the design and construction of canals, flumes and other special means for supplying water to the soil. This is followed by a course in drainage designed to familiarize the student with the best methods of surveying and construction of drainage systems for large areas.

Prerequisites: Course 23 of this department.

Time: Three hours a week.

Text: To be determined at beginning of term.

9. Stresses.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow, and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind, and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisite: Course 6 of this department.

Time: Class-room, two hours a week, one year.

Text: Merriman & Jacoby, *Roofs and Bridges,* Parts I and IV.

10. Structural Details.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures. Each student makes a detailed design of a steel roof truss with its supporting columns, a plate girder bridge for railroad traffic, and a highway Pratt truss span.

Prerequisites: Course 6 of this department and Course 9 of this department must accompany.

Time: Laboratory, nine hours a week, one year.

Text: Merriman & Jacoby, *Roofs and Bridges,* Part III.

11. Water supply Engineering.

The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, method of collecting, storage and

distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours, first semester.

12. Masonry.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cement, wood, iron and steel. Special emphasis is placed upon the geological occurrences to the suitable engineering materials and their methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood pipe, and stone arches.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours a week, first semester.

Text: Baker, *Masonry Construction.*

13. Sanitary Engineering.

A study of the quantity of house-sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 12 of Department VIII.

Time: Class-room, five hours a week, second semester.

Text: Folwell, *Sewerage.*

14. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustra-

tions and descriptions of a large number of representative structures, properties and methods of testing the materials used. various types of reinforcement, forms, facing and finishing.

Prerequisite: Courses 9 and 12 of this department.

Time: Class-room, three hours a week, second semester.

15. Wood-shop.

The student is taught the use and care of wood working tools. Exercises in simple joints are then assigned and whenever possible useful exercises will be given.

Time: Work-shop, three hours a week, first semester.

16. Forging.

Exercises in drawing, shaping, upsetting, tempering, and welding. Some bench-work in chipping, filing, and rasping is also given.

Time: Work-shop, three hours a week, second semester.

17. Mechanical Drawing and Lettering.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represened.

The latter part of the semester is devoted to special practice in lettering and free hand sketching.

Prerequisites: Entrance requirements.

18. Machine Drawing.

A continuation of Course 18. Here the student makes working drawings from machine parts already made; first while having the part directly before him, and later from a free-hand sketch of the part, without having the latter to look at while drawing. He thereby becomes familiar not only with methods of dimensioning, laying out and reading working drawings but also those of making and using sketches. Through the entire course, particular stress is laid on neat lettering, correct dimensioning, and symmetrical arrangement of drawings.

The student is also taught tracing and blue printing.

Prerequisite: Course 18 of this department.

Time: Laboratory, six hours a week, second semester.

Text: Williams & Rautenstrauch.

19. Machine Design.

A study of the design of machine elements and modern machines, and of the nature, strength, and action under stress of the materials used in the machine construction. Recitations are carried on, including the discussion of problems suitable for illustration of important points. In the drafting room each student completes the design of some specially assigned simple machine.

Prerequisites: Courses 18 and 19 of this department; Course 6 of Department IV must precede or accompany.

Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second semester.

20 Descriptive Geometry.

The representation of all geometrical magnitudes are made possible by means of orthographic projection. The student is required to solve various problems involving points, lines, surfaces and solids and demonstrate same in exercises at the blackboard. A thorough knowledge of descriptive geometry is indispensable to the engineer.

Prerequisites: Course 2 of Department I, and Course 18 of this department must precede or accompany.

Time: Class-room, two hours a week, second semester.

Text: Church, *Descriptive Geometry.*

21. Steam Engines and Boilers.

In this course an elementary course in thermodynamics is given followed by the theory of the steam engine based on thermodynamics. This, in turn, is followed by a general descriptive course on engines and boilers, their types, details, construction and management. The whole course is supplemented by suitable problems to aid the student in his understanding and grasp of the subject.

Prerequisites: Courses 1 and 2 of Department II.

Time: Class-room, five hours a week, first semester.

Texts: Peabody and Miller, *Steam Boilers and Engines.*
Ripper, *Steam Engines.*

22. Hydraulics.

Under this head are treated fluid pressure, the principles of fluid equilibrium, and the laws governing the flow of water

through orifices, over weirs, in closed conduits, and in open channels. The hydraulic laws relating to turbines and centrifugal pumps are briefly discussed, showing to what extent theory applies to these subjects.

Prerequisites: Course 4 of Department II and Course 6 of Department IV.

Time: Class-room, three hours a week, first semester.

Text: Merriman, *A Treatise on Hydraulics.*

23. Air Compression and Pumping.

Part 1: Discussion of pumping, pump problems, and pump details. Types of Pumps: Force pumps, crank and fly wheel, direct acting, duplex, compound, and triple expansion pumps.

Part 2: A study of the action of air during compression and expansion, its flow through pipes, and also of the various types of air compressing and actuating machinery.

Prerequisites: Course 22 of this Department and Course 2 of Department VI.

Time: Class-room, three hours a week, second semester.

Texts: Barr, *Pumping Machinery.*
Peele, *Compressed Air Plant.*

24. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, second semester.

Text: Johnson, *Engineering Contracts and Specifications.*

V. DEPARTMENT OF GEOLOGICAL ENGINEERING

PROFESSOR ANDERSON.

This department aims to give its students knowledge concerning bodies of ores and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditions, so that mining may become more and more a business and that the element of chance may be lessened.

1. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals, rapid sight determination of unlabeled specimens being especially emphasized.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is

given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts, salts of the organic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 2 of Department III.

Time: Class-room, three hours a week, one year.

Texts: Rogers, *Study of Minerals.*
Brush and Penfield, *Determinative Mineralogy and Blowpipe Analysis.*

2. General Geology.

All the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory work in the rock collections, and in study and interpretation of topographic maps, and frequent excursions into the field. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail, training in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena

are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Limitar mountain, ten miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, first semester.

Texts: Chamberlain and Salisbury, *College Geology.*
Scott, *Introduction to Geology.*

3. General Geology.

Discussion of theories of earth genesis, the principles of stratigraphy, and the geologic history of the development of the North American continent, involving laboratory work with type fossils and rock collections.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Text: Chamberlain and Salisbury, *College Geology.*

4. Field Geology.

Each student is assigned a limited area within the Socorro Quadrangle. Instruction is given in the field in observing and recording geological phenomena and the preparation of maps and sections. The collections made are then studied in the laboratory and a complete report describing the geology of the area is required.

Prerequisites: Course 3 of Department IV and Courses 1, 2, and 3 of this department.

Time: Saturdays, first semester.

5. **Economic Geology.**

This course embraces the study of the theories of ore deposition and the general features and formation of ore bodies and classification of ore deposits. This is followed by a description of the deposits of the ores of iron, copper, lead, zinc, silver, gold, and the lesser metals, with special reference to North America.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three hours a week, first semester.

Text: Kemp, *Ore Deposits of the United States and Canada.*

6. **Economic Geology.**

This course embraces the study of the non-metallic minerals of economic importance. A description of the distribution and occurrences of coal, petroleum, natural gas, asphalts, building stones, water supply, clays, cement rock, salt, gypsum, sulphur, fertilizers, abrasives, gems, and minor minerals.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three hours a week, second semester.

Collateral readings and reports on assigned topics are required of students in Mining Geology.

Time: Laboratory, three hours a week, one year.

7. **Petrology.**

A discussion of the origin, mineralogical and chemical composition, field classification and nomenclature, and microscopic structure of the crystalline, sedimentary, and metamorphic rocks. This is supplemented by field and laboratory work in the rock collections.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, three hours a week, one year.

Texts: Kemp, *Handbook of Rocks and Lecture Notes.*
Luquer, *Rocks in Thin Sections.*

8. Geological Examinations and Surveys.

A discussion of the methods of systematically recording and interpreting geological phenomena, and the organization and scope of geological surveys. This is followed by a sketch of the history and results of state and national geological surveys in the United States, and of other sources of detailed information regarding local geology.

Prerequisites: Courses 1, 2, 3, 5, and 6 of this department.

Time: Class-room, two hours a week, second semester.

9. Ore Genesis.

The study of the paragenesis and origin of the minerals of a certain ore deposit. The student makes a collection of the deposit which is then studied in the laboratory by means of microscopic slides and polished surfaces and microchemical tests, etc.

Prerequisites: Courses 1, 2, 3, 4, 5, and 6 of this department.

Time: Laboratory, six hours a week, first semester.

10. Paleontology.

A study of the invertebrate index fossils characteristic of the geologic horizons of North America.

Prerequisite: Course 3 of this department.

Time: Class-room, two hours a week, second semester.
Laboratory, six hours a week, second semester.

Text: Grabau and Shimer, *North American Index Fossils.*

11. Special Problems.

Research work in some branch of the science of geology, such as investigation in petrology, stratigraphy, paleontology, or ore deposits. This work may form the basis of a thesis in Geological Engineering.

Prerequisites: Courses 3, 5, 6, and 7 of this department.

Time: Laboratory, five hours a week, second semester.

VI. DEPARTMENT OF MINING ENGINEERING

PROFESSOR STRIEF.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical park of the work. The entire course is pre-eminently practical in character.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Prospecting by panning, trenches, test pits, boring and drilling. Testing of placers and ore deposits with well or chain drills.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts; quarrying.

Machine drills: Construction and operation.

Tunneling: Methods of driving and timbering; permanent linings; sizes; speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Methods of support: Pillars, timbers, filling.

Excursions are made to neighboring mines on Saturdays.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 1 of Department III.

Time: Class-room, three hours a week, first semester.

Texts: Foster, *Elements of Mining and Quarrying.*
Lecture Notes.

2. Mining, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Ore extraction by systems of overhand and underhand stoping; caving by top slicing and sub-drifting; support of workings by filling and square-setting.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives.

Hoisting: Engines, drums, wire rope, skips and cages; headframes; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Arrangements at top and underground landings: Ore pockets; signalling, etc.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiency of fans.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, three hours a week, second semester.

Texts: Same as in Course 1.

3. Elements of Mining.

This course covers, in a general way, the work included in Courses 1 and 2 of this department. Being intended for those specializing in Metallurgy, only the fundamentals of mining are given and the student is equipped to read mining literature understandingly. In case, later, he is lead into mining work, he has the foundation upon which he can build up along the particular line in which he is interested. In this course the

same trips are made that the regular students make in Course 1.

Prerequisites: Same as for Course 1 of this department.

Time: Class-room, three hours a week, first semester.

Text: Foster, *Elements of Mining and Quarrying.*

4. Mine Economics.

Among the subjects studied are: Factors governing the value of a mine; relation of labor, selling price of products, and profit; amortization of capital; ore sorting and its relation to profit; comparative efficiency of mining methods, plants, etc.; balancing the cost of mining equipments against the saving effected to see whether or not the installation is advisable.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hoover, *Principles of Mining.*
Lecture Notes.

6. Ore Dressing.

This course includes a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil flotation.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 12 of Department VIII must precede or accompany.

Time: Class-room, three hours a week, first semester; two hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration.*

7. Mine Administration and Accounts.

Particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of supplies, mine accounts, statement of cost, and monthly reports are discussed.

Time: Class-room, two hours a week, second semester.

8. Examination of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside construction, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant.

Time: Class-room, one hour a week, second semester.
Field, three hours a week, second semester.

9. Design of Mine Plant.

The student is assigned problems relating to a given mine. He makes the requisite surveys, plans the top-works, selects the requisite machinery for a specified duty, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or of the Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings.

Time: Laboratory, three hours a week, first semester; six hours a week, second semester.

10. Mine Surveying and Mapping.

The work consists of field practice, recitations and drafting room exercises.

In the field surveys of mining claims and underground workings are made. The mapping is done in the drafting room from the notes thus taken.

Prerequisites: Courses 1 and 18 of Department IV.

VII. DEPARTMENT OF METALLURGICAL ENGINEERING

PROFESSOR STRIEF.

The aim of the Metallurgical Department is to give its graduates a thorough working knowledge of assaying, chemistry, mill-work and smelting processes; and to equip them with the knowledge necessary to the successful management of metallurgical plants, or to take charge of metallurgical operations.

This special training is given by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead. The crucible-assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assayers are considered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Course 3 of Department III, and Course 1 of Department V.
Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.
Text: Lodge, *Notes on Assaying.*

2. General Metallurgy.

This course is intended to give the mining engineer a broad general knowledge of metallurgy. After a brief discussion on fuels, refractories, and furnaces, the various methods of roasting an ore are considered. The balance of the semester is spent in studying the theory of the process, the plant required, and the mode of operation in the reduction of each of the following metals: gold, silver, copper, lead, iron, and zinc. Visits are made to neighboring plants.

Prerequisites: Course 1 of Department II; Course 1 of Department III; and Course 1 of Department V must precede or accompany.
Time: Class-room, three hours a week, first semester.
Text: L. S. Austin, *Metallurgy of the Common Metals.*

3. Principles of Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

Particular stress is laid upon the study of the more recent metallurgical practices and improvements of older processes. The course is supplemented by visits to neighboring plants.

Prerequisites: Course 1 of Department II; Course 1 of Department III; and Course 1 of Department V must precede or accompany.
Time: Class-room, three hours a week, first semester.
Text: Fulton, *Principles of Metallurgy.*

4. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet types of ore hearth; smelting lead

ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.

Time: Class-room, two hours a week, first semester.

Text: Peters, *Principles of Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel process; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixivation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.

Time. Class-room, three hours a week, first semester.

Texts: McFarren, *Cyanide Practice.*
Del Mar, *Stamp Milling.*

7. Metallurgy of Iron.

Modern methods for the production of pig iron, wrought iron and steel; the iron blast-furnace; white cast-iron, gray cast-iron and spiegel-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, second semester.

Text: Stoughton, *Metallurgy of Iron and Steel.*

8. Furnaces.

This course is given by way of an extension of the topic "fur-

naces'' as treated in Principles of Metallurgy. It is concerned with the theories of high temperature generation, heat conservation, measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three hours a week, second semester.

Text: Damour, *Industrial Furnaces.*

9. Metallurgical Plant and Design.

The student devotes his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two students have the same work. The working plans for part of the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bills of materials made out for the portions of the work assigned, and the cost of the several parts carefully estimated according to the trade conditions and labor factors existing at the time. The entire work and all computations are carried out according to the best engineering practice and with the same care that actual construction operations require.

Prerequisites: Course 6 of Department IV; Course 6 of Department V; Course 23 of Department IV; and Course 2 of this department.

Time: Laboratory, three hours a week, first semester, and six hours a week, second semester.

10. Metallurgical Laboratory.

Laboratory work and investigation will be conducted along some of the following lines: Amalgamation of ores of gold and silver, chlorination of gold and silver ores, cyanidation of gold and silver ores, leaching methods for copper ores, electrolytic refining for copper and lead, slags.

Prerequisites: Courses 4, 5, 6, and 7 of this department must precede or accompany this course.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Mining and Metallurgical Trips.

During the first semester of the junior year a number of trips are taken to the mines, mills, and smelters which are within easy reach of the School. The officials at the various plants

have been uniformly courteous in allowing the School the opportunity to make these visits, and have placed at the disposal of the students everything essential to a clear understanding of the mode of operation.

These excursions give the student a chance to see in operation and practice what heretofore he may have known only theoretically and give him a command of the subject that cannot be obtained in the class room.

Among the properties visited and at the disposal of the School are:

The old Torrance and Merritt mines, three miles from the campus, in the Socorro Mountains. These mines were once rich producers but are now being re-exploited.

The Merritt Mine has an incline shaft equipped with gasoline hoist and self-dumping skip, and a considerable amount of drifting, raises, winzes, and stopes. Practically all the operations of mining may be seen at these two mines.

The coal mines at Carthage, New Mexico, are within easy reach of the School and present to the student difficulties, and their solution, in mining, haulage, ventilation, and water supply. The use of electricity in mining is prominently brought to the student's notice.

The zinc district at Kelly, New Mexico, brings out the fact that success in mining is not all luck. There are three large mines and two mills available for inspection, and the student sees in the mines that his geology is a live subject and essential to successful mining. In the mills, he gets his first insight into ore dressing and learns that there is more than one way of doing the same thing.

The Southwestern Portland Cement Company's plant at El Paso is visited and studied from the machanical point of view. Here are seen in action various types of crushers, grinders, elevators, conveyors, feeders, etc. The company's quarry is a fine example of open cut mining and the student sees the uses of churn drills in drilling holes for blasting large charges.

A new custom smelting plant is now in course of erection in the southern part of the city by the Socorro Smelting Company. This plant when completed and in operation will afford an excellent opportunity for students to observe actual smelting practice right at the doors of the school.

At the smelter in El Paso, the student sees the working and handling of a large custom plant. Practically everything in the line of copper, lead, and silver smelting is before him for inspection. The methods of sampling, the blast roasting of lead ores, the roasting of copper ores, the blast furnace treatment of lead-silver ores, the blast furnace treatment of copper ores, the reverberatory smelting of copper ores, basic converting, casting machines, power houses, and assay offices are all made the subject of close observation.

Once in two years, a trip, open only to students who have taken work in the Mining or Metallurgical departments, is taken through the Southwest. The probable itinerary of this trip is as follows: Santa Rita, Hurley, Morenci, Clifton, Globe, Miami, Tombstone, Bisbee, Cananea, and Douglass.

ACADEMIC DEPARTMENT

PRINCIPAL GUNTER.

The minimum requirements for admission are one year of high school work consisting at least of one unit in English, one in algebra, and one optional. A two-year course is given corresponding closely to the tenth and eleventh grades of standard high schools.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

SECOND YEAR—FIRST SEMESTER.

Elementary Algebra.

A rapid review of factoring, linear equations, and square root and radicals is given during the first month. Quadratics including graphic representation, irrational equations, variations and the binominal theorem for positive and negative exponents are given special study.

Time: Five hours per week.

Texts: Hawkes, Luby and Touton.

English II.

Classics: Standard English and American classics are read and discussed in class, the memorizing of some of the most significant passages is required. An attempt is made to cultivate a taste for good literature. Supplementary reading from approved authors required.

Rhetoric: This deals with language as a medium through which ideas and thoughts are expressed; Description, Narration, Exposition and Argument.

Composition: Ability to write English.

Time: Five hours per week.

Texts: Brooks and Hubbard.

Plane Geometry.

Triangles, quadrilaterals, loci, arcs, chords, measure of angles and simple problems in construction are studied. They are developed by the inductive-deductive method, the inductive predominating.

Time: Five hours per week.

Texts: Wentworth and Smith.

SECOND YEAR—SECOND SEMESTER.

English II.

In this subject the work of the first semester is continued. *The Merchant of Venice* and *Hamlet* are read and discussed in class. As in the first semester, appropriate supplementary matter is read by each pupil.

Time: Five hours per week.

Texts: Brooks and Hubbard, *Composition and Rhetoric.*

Plane Geometry.

Work of first semester is continued. Books III, IV and V are studied. Deductive proofs predominate. The work is vitalized by solutions of simple exercises and practical problems requiring the use of the algebra of the previous year.

Time: Five hours per week.

Texts: Wentworth and Smith.

THIRD YEAR—FIRST SEMESTER.

English III.

I. History of American Literature.

II. Ability to Write Formal Themes.

III. Knowledge of American Literature: Washington's Farewell Address; Webster's Bunker Hill Oration; One Essay from Emerson; Holmes' Poems (selected); Hawthorne's Short

Stories; Marble Faun, or House of Seven Gables; Longfellow's Poems (selected); Lowell's Poems (selected); Short Stories from Poe; One Novel from Cooper.

An intensive knowledge of four of the above and a general reading knowledge of the others is required.

Time: Five hours per week.

Texts: Selected.

Physiography.

This course furnishes preparation for the college work to follow. It is largely geological. Erosion, the work of ground water, rivers and valleys, the sea and its shores, and movements of the earth's crust are studied. Laboratory work in which maps, rock formations, etc., are examined and studied is given in connection with the special topics.

Time: Five hours per week.

Physics.

This course runs throughout the entire year the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. During this semester the subjects of mechanics, heat and work are studied.

Time: Four hours a week in class, with three hours laboratory.

Text: Millikan and Gale's *First Course in Physics,* with laboratory manual.

THIRD YEAR—SECOND SEMESTER.

English III.

I. History of English Literature.

II. Ability to Write Formal Themes.

III. Knowledge of English Literature: Burk's Speech of Conciliation; Macauley's Life of Johnson; Shakespeare's Macbeth, Hamlet, or King Lear.

Time: Five hours per week.

Text: Long, *English Literature.*

Physics.

This is a continuation of the first semesters work. Sound, light and electricity are treated in much the same manner as the subjects of the first half of the year. Throughout the course individual laboratory work is required. Each student must present a satisfactory note book of at least forty experiments performed by him during the year before credit will be allowed by instructor.

Time: Class-room, three hours per week.
Laboratory, six hours per week.

Texts: Millikan and Gale, *Laboratory Manual.*

Solid Geometry.

The work for the second semester includes the usual theorems and constructions of good text books covering the relations of lines and planes in space; the properties and measurements of prisms, pyramids, cylinders, and cones; the sphere; and the spherical triangle.

Time: Five hours a week.

Text: Wentworth and Smith, *Solid Geometry.*

Drawing.

Instruction in elementary drawing is given during the entire course in the Academic School. Such practice prepares the student for the more advanced work in the College courses.

Industrial Training.

Elementary shop practice is given academic students who are not otherwise overburdened with work. The scope and arrangement of shop work will be made by the instructor in charge. Students who do not intend to take a full college course will do well to take advantage of work in the shop.

FOREIGN LANGUAGES.

No foreign language is taught except Spanish, a speaking knowledge of which has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention

is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge, for in Socorro and vicinity Spanish is as generally spoken as English.

1. Spanish.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercise each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language with the idea of learning the grammar from the language rather than the language from the grammar.

Time: Five hours a week, one year.
Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish.

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar* being used as a text. Five periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.
Time: Five hours a week, one year.

Instruction in Spanish is given by a Spanish-American who holds a scholarship in the institution. Such instructor is named at the beginning of the school year by the president. Two units are required in either Latin, Greek, French, German or Spanish for graduation from the college.

ACADEMIC CLASS SCHEDULE, FIRST SEMESTER.

HOUR	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8–9	Algebra II	Algebra II	Algebra II	Algebra II	Algebra II	Drawing
9–10	English III	English III	English III	English III	English III	Drawing
10–11	Physiography	Physiography	Physiography	Physiography	Physiography	Drawing
11–12	Plane Geometry	Plane Geometry	Plane Geometry	Plane Geometry	Plane Geometry	Drawing
P. M. 1–2	English II Spanish	English II Spanish	English II Spanish	English II Spanish	English II Spanish	
2–3	Physics	Physics		Physics	Physics	
2–5			Physics Laboratory			

ACADEMIC CLASS SCHEDULE, SECOND SEMESTER.

HOUR	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8–9	Solid Geometry	Solid Geometry	Solid Geometry	Solid Geometry	Solid Geometry	Drawing
9–10	English III	English III	English III	English III	English III	Drawing
10–11	Plane Geometry	Plane Geometry	Plane Geometry	Plane Geometry	Plane Geometry	Drawing
11–12	Algebra II	Algebra II	Algebra II	Algebra II	Algebra II	Drawing
P. M. 1–2	English II Spanish	English II Spanish	English II Spanish	English II Spanish	English II Spanish	
2–3	Physics		Physics	Physics		
2–5		Physics Laboratory			Physics Laboratory	

BUILDINGS AND GROUNDS

BUILDINGS AND GROUNDS

The Campus.

The State School of Mines campus contains 20 acres of nearly level ground on the outskirts of the city of Socorro. Groves of trees have been planted and trees line the walks and drives.

Main Building.

The main building consists of three stories and a good basement. It is T-shaped, 135 feet long by 100 feet deep, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite in broken ashler and is trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated, heated with a good hot-water system, piped for water and gas, and wired for electricity for illumination and for experimental purposes.

As now arranged the main floor of this building contains the president's office, the mineralogical museum, the qualitative chemical laboratory and instructor's office, the assay laboratory and balance rooms, and a lecture room. The basement contains two lecture rooms, the physical laboratory, and instructor's private mineralogical laboratory, the quantitative chemical laboratory, the electro-chemical laboratory, an instructor's private chemical laboratory, the chemical supply rooms, a photographic dark room, the boiler room, the engine room, the hot water heating plant, and the lavatories. A lecture room, now occupied by the department of mathematics, is located on the second floor. The main library occupies the third floor.

Mechanical Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion the building is to be X-shaped, when finally completed and have four wings one story. The central east and west portion of this building is expected to be completed during the summer and metal lathes and wood turn-

ing lathes will be installed ready for instruction and use when the fall term opens.

A blue print room is now provided for in the wing already constructed and is conveniently arranged and appointed for the needs of map reproduction.

Dormitory.

The State School of Mines suffered long for lack of dormitory accommodations. In fact, it is known that many students who would otherwise have come to the State School of Mines in years past went to other institutions because of the lack of the lower cost of living which a dormitory here would have afforded. However, the $15,000 generously appropriated by the territorial legislature was expended with the result that the School of Mines is equipped with what is probably the best dormitory in New Mexico. The building is heated with hot water and lighted with electricity. There are a dining room and kitchen in connection, also a bath room on each of the two floors and a shower bath in the basement. The assembly room, on the first floor, which is now equipped for the accommodation of the academic department, promises to meet all the requirements of that department for some time to come. The building is designed to afford accommodations for about thirty students and from time to time has been occupied to practically its full capacity.

Students are accommodated with board and lodging at the dormitory at the rate of $20 a month, they being required to furnish only their own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself, and no student will be accommodated in this way to the exclusion of another student from dormitory privileges. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture. After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application. Dormitory privileges will be withdrawn from any student for boisterous and disorderly conduct in violation of

the rules and regulations governing their action while in or about the building. The privilege of the dormitory is, therefore, for students of good behavior and who wish to study, without being interrupted.

Conduct of Students.

In the government of the School of Mines the largest liberty consistent with good work is allowed. Students are expected to conduct themselves as gentlemen upon all occasions and to show such respect for law, order, morality, personal honor, and the rights of others as is demanded of good citizenship. It is also hereby expressly stipulated that the use of intoxicating liquors, whether inside or outside the campus and the frequenting of saloons and other places of questionable character are strictly prohibited. It is assumed that the act of registering as a student implies full acceptance of this policy. Failure on the part of any student to comply with this policy will be considered sufficient cause for removal from the institution.

EQUIPMENT.

Chemical Laboratories.

The chemical laboratories have recently been greatly enlarged and improved. As now arranged they occupy the entire south wing of the main building, while the store room, private laboratory, and chemical lecture room are located in the central section of the same building. Elements of chemistry and qualitative analysis are taught in the large laboratory on the main floor. The room, which is exceptionally well lighted and ventilated, is equipped with large hoods, a balance room, and twenty-four desks, each of which is supplied with gas, water, and electric light.

The basement laboratory has recently been remodeled and fitted with large windows, glass partitions, and modern desks. The east half of it is used for quantitative analysis and wet assaying. There are large hoods in each end which are supplied with hot plates and drying ovens, while each desk is equipped with an Alberine stone sink, water, gas, and electric light.

In the west half of the basement there are the instructor's

laboratory, electro-chemical laboratory, and balance room. The latter is fully equipped with the best analytical balances supported upon a solid concrete table which is entirely free from vibration. The electro-chemical laboratory is supplied with current from a modern storage battery plant, consisting of a motor-generator, storage cells, and a switch-board so arranged that each student may obtain any current he desires for analytical or other electro chemical experiments. There is also a supply of alternating current from the city circuit which is used for light and small electric furnaces.

The laboratory is very completely equipped not only with all apparatus, chemicals, and supplies needed for the various courses, but the stock includes a large amount of pure chemicals and special apparatus, including standardized burettes, flasks, and weights which are used for the most accurate rock analysis and research work.

All apparatus is loaned to the students. Chemicals and supplies are furnished at cost.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types and large muffle coal and coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes, and other assaying materials and supplies.

A weighing-room containing a number of Becker's balances is conveniently located between the furnace-room and the lecture-room. In the grinding room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher and a Bolthoff sample-grinder and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers, and other necessary apparatus.

Physical Laboratory.

The physical laboratory occupies the east side of the north basement of the main building and contains the usual apparatus for illustrating the facts and laws of physics. In addition there has just been added at a considerable expense all the apparatus

necessary to perform the quantitative experiments outlined in Course 2 of Department II.

Petrographical Laboratory.

For the miscroscopic study of rocks both in elementary and advanced or graduate work the School is well supplied with rocks in thin sections representing the various types of igneous, metamorphic, and sedimentary rocks accompanied by hand specimens, giving the student an opportunity to study the microscopic and megascopic characters of the rocks at the same time. The laboratory is well equipped with standard up-to-date microscopes with all accessories; also, a camera for microphotographic work with accessories for oblique and vertical illumination; also, a rock slicing machine with electric power attachment where the students in petrography are taught how to make and mount thin sections.

Mineralogical Laboratory.

For the study of minerals by physical characters and blow pipe test, the School is especially well provided with an abundance of material of various ores and minerals for blow pipe determinations. Large collections for this purpose have recently been added to the School and the minerals are so arranged that no two students work with the same minerals the same day, thereby stimulating thorough systematic search for the elements and correct determination of the mineral specimens. The laboratory is well equipped with all necessary apparatus to carry on this work in an efficient and up-to-date manner.

Mineralogical Museum.

The Mineralogical Museum, with instructor's office, occupies the entire north wing of the first floor of the main building The School owns a very fine collection of minerals and rocks of all kinds. These are arranged systematically, forming units for the various courses in Geology rather than for showy display. The minerals and rocks from the various mining districts are segregated, thereby giving the student the best possible opportunity of studying the ores and rocks of a district without having actually visited the field. The Museum is well supplied with such district collections throughout the United States, Mexico, and Canada. New specimens are being added most every day in the year.

ENGINEERING INSTRUMENTS.

The Civil Engineering Department has all the instruments necessary for land, railroad, irrigation, mine, and topographic surveys. These include chains, tapes, range-poles, level rods, wye and dumping levels, complete transits, and plane tables. In purchasing instruments for this department only the best grade has been considered and the student has the opportunity to become familiar with the product of such well known manufacturers as Gurley & Sons, Eugene Dietzgen, Buff & Buff, etc.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the mechanical building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame on steel track, developing-vat, and drying rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. An Ingersoll-Rand drill and other pieces of machinery are used as models.

LIBRARIES.

The libraries of the New Mexico State School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats, and at lases, and volumes on history, travel, and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.
Mining and Scientific Press.
Engineering Record.
Power.
Engineering News.
Mining Science.
The Mining World.
Mines and Minerals.

Engineering Magazine.
Journal of the American Chemical Society.
Journal of Industrial and Engineering Chemistry.
Chemical Abstracts.
Geographic Magazine.
Economic Geology.
School of Mines Quarterly.
New Mexico Journal of Education.
All the U. S. Geological Survey Publications.
U. S. Bureau of Mines Publications.
Canadian Geological Survey Publications.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions and author's separates, pertaining to the respective divisions.

Powell Library.—The School has come into possession of the private library of the late Major John W. Powell of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology, philosophy and many rare monographs of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who has been so long identified with this western country, should find a permanent home in New Mexico.

SOCORRO MOUNTAIN MINES.

The gold and silver mines at the base of Socorro mountain, only about two miles west of the School campus, afford excellent opportunities for the practice of mine-surveying and for a study of some features of practical mining. The ore-bodies with associated geological structures and many other features will interest the student of mining and geological engineering.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is fifteen dollars a semester except to citizens of New Mexico, the tuition fee for the latter being five dollars a semester. This is payable at registration, and its payment after matriculation admits the student to all class-room instruction. Students who hold scholarships pay no fee for tuition.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Quantitative Analysis, Water and Fuel Analysis, Inorganic Preparations, Organic Chemistry, Electro-Analysis, Photography, Physics, each \$5.00; Qualitative Analysis, Ore Analysis, each \$7.50; Fire Assaying, \$10.00; Mineralogy (Blowpipe Analysis), \$6.00; Metallurgical Laboratory, \$3.00; Shop, \$3.00; Mine Examination, \$1.00.

A deposit of \$2.00 is required from each student who registers for any of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due from the breakage of apparatus.

Graduation Fee.

The graduation fee, payable after delivery of diploma, is as follows:

Mining, Metallurgical, Geological or Civil Engineer......\$10.00
Bachelor of Science.................................. 5.00

Board and Rooms.

Rooms may be obtained at a cost varying from \$6.00 to \$8.00 a month; board at the hotels and best boarding-houses for \$7.00 a week. The cost of living at the dormitory is \$20 a month.

Books and Other Supplies.

Books and other supplies for students are furnished through the office at publishers' prices with the freight or express charges added. A considerable saving is thus made in behalf of the student.

Summary of Annual Expenses.

A close approximation of a student's necessary annual expenses is tabulated below. By the practice of extreme economy a student may, of course, cut his expenses somewhat below the figures here given:

Board and room at the dormitory	$180.00
Books and other supplies	60.00
Laboratory and other fees	25.00
Total	$265.00

SCHOLARSHIPS.

There are a few scholarships available each year in this institution which carry with them certain emoluments in cash and free tuition.

Teaching Scholarships.—Through the wisdom of the Board of Regents of the School of Mines there have been provided from two to five scholarships, discretionary to the president, carrying free tuition and from $150 to $200 per year. These scholarships are awarded only to worthy young men who have satisfactory completed at least the College freshman work and who are otherwise worthy of recognition. The students carrying such scholarships shall be selected by the president, and they shall be required to give from one hour to not more than two hours instruction in the class room during the active school year, in the Academic or such work in the College as they may be qualified in or are capable of doing.

School of Mines County-Scholarships.—Scholarships are open to one student from each county in New Mexico. These scholarships yield free tuition and are awarded by the president to indigent and worthy students.

Allis-Chalmers Scholarship.—To one member of each year's

graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opportunity for four months' study and employment in any of its plants and an emolument of $150.00. This scholarship is awarded by the Board of Regents on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

SUMMER WORK.

The proximity of the School to mineral properties, mines, and smelters makes it easy for the student to secure employment during the summer and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining, have been attractive fields of work for the students during the vacations.

DEGREES.

The degrees of Bachelor of Science, Mining Engineer, Metallurgical Engineer, Geological Engineer, and Civil Engineer are conferred by the Board of Regents upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of the institution, have completed the prescribed collegiate courses of any one of the several curricula. This degree is also conferred upon those who, as students of this

institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed course of the four-year curriculum in Mining Engineering, has presented an original and satisfactory dissertation in the line of his work, and has done two years of professional work of which one has been in a position of responsibility. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum, and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Metallurgical Engineer, Geological Engineer, and Civil Engineer is offered upon terms similar to those required in the case of the Mining Engineer.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but in each case the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidence of independent investigation to warrant its publication in whole or in part.

CHEMICAL ANALYSIS, ASSAYING, AND ORE TESTING.

The wide demand which exists in the great mining districts of the Southwest for disinterested and scientific tests and practical investigations has led to the establishment by the New Mexico State School of Mines of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible and accurate results assured by reason of the exceptional facilities of the laboratories of the School and the extensive practical experience

of the instructors. The rapidly increasing amount of this work intrusted to the School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special Act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines." By special resolution it is required that all charges shall be paid in advance. Prices for work will be sent on application.

FREE DETERMINATIONS.

For the benefit of prospectors and others, elementary blow-pipe and physical tests will be made of any rocks, ores or other mineralogical material when sent to the School for their proper classification and determination. Such work is done to encourage prospecting and to more fully exploit the mineral resources of New Mexico, so little comprehended at the present time. For such work as indicated in this paragraph no charges will be made.

NEW SPECIAL APPROPRIATION.

During the legislative session of the present year, the Legislature provided a special appropriation of $20,000 to be expended in electrical, power, and metallurgical equipment for practical and demonstrative work in the methods of ore dressing, milling, etc. This equipment will be of the most modern type of machinery and will be ready for use when school opens next fall.

CALIFORNIA-PANAMA EXPOSITION

New Mexico was the first state to begin construction of its building at the San Diego Exposition. For a model the State Board of Exposition Managers took the historic church on the Rock of Acoma, adding to it a veranda and balustrade of the Franciscan Mission at Cochiti. This combination has provided a structure for New Mexico's exhibit that is the most striking of all exposition buildings, and one that is quite in harmony with the general architecture of the San Diego Exposition.

The location of the New Mexico builidng on the Exposition site at Balboa Park is on an eminence to the south and west of the main group of exhibit buildings, on the edge of a canyon, and with a commanding view of the ocean, bay, city and mountains. Its striking proportions are plainly seen by all visitors to the Exposition grounds, from the great viaduct which forms the approach from the west. It completes a picture that is absolutely beautiful and unique.

The New Mexico Board of Exposition Managers early decided that the most effective way of presenting the varied industries and natural resources of the state to those who visited San Diego in 1915 would be by carefully prepared lectures, supplemented with colored stereopticon views and moving picture scenario. Such lectures will be carried on during the whole time of the Exposition. Among the many interesting industrial features portrayed in moving pictures will be that of mining. The great mining enterprises, carried on by some of the largest operators in the world, in gold, copper, iron and coal, are certain to prove impressive sights in conveying to the mind something of the marvelous mineral wealth of the state. The output from the mines of New Mexico will reach approximately $20,000,000 in 1915.

In addition to the scenario illustrating the varied mining industries, there will be a comprehensive collection of the rare and economic minerals of the state displayed in exhibit hall in

the New Mexico building throughout the life of the Exposition. A publicity mining bureau will be established and every effort will be extended in supplying literature, maps, and like information to those interested in the geology, mineralogy, and mining economics of the state.

President Fayette A. Jones of the School of Mines was appointed Mining Commissioner of the New Mexico Board of Exposition Managers and had direct charge of collecting and assembling the mineral and geological exhibit, which is said to be among the best ever assembled on the Pacific coast. All the exhibits installed in the New Mexico building are highly instructive and the building is a Mecca for the educators of the country.

It is thus seen that the New Mexico State School of Mines is officially connected with the San Diego Exposition and much good is expected to redound from this relation both to the School and in the further development of the mineral resources of the commonwealth.

DIRECTORY OF GRADUATES AND STUDENTS

DIRECTORY OF GRADUATES AND STUDENTS†

ARTHUR H. ABERNATHY — Mapimi, Mexico.
Student, 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, Cananea, Sonora, Mexico, 1901; Assistant sampleman, Cia. Minera de Penoles, Mapimi, Durango, Mexico, 1909-1910; Sampling foreman same company, 1910-1914; Special student at New Mexico School of Mines, 1914-1915; Sampling foreman Cia. Minera de Penoles, Mapimi, Durango, Mexico, 1915—.

ANTONIO ABEYTA — Pachuca, Mexico.
(B. S. in Metallurgical Engineering, New Mexico School of Mines, 1914.)
Foreman at San Gertrudes Mine, Pachuca, Mexico, 1914—.

RAY COOK AHNEFELDT
Entered 1913, from Riverside, Cal. Candidate for B. S. degree in Civil Engineering.

GEORGE C. BAER — Mogollon, New Mexico.
(B. S. in Mining Engineering, New Mexico School of Mines, 1910.)
Student, 1907-1910. From Hillsdale, Michigan. Assayer, Tri-Bullion Company, Kelly, New Mexico, 1910; Millman, Socorro Mines Company, Mogollon, New Mexico, 1911; Mill foreman, same company, 1912; Engineer, same company, 1912—.

JAMES HENRY BATCHELDER, JR. — Socorro, New Mexico.
(B. S., New Mexico School of Mines, 1909; E. M., 1910.)
Student, 1906-1910. From Exetor, New Hampshire. Mining, Chloride, New Mexico, 1911; Farming, San Acacio, New Mexico, 1911—.

THOMAS HORTON BENTLEY — Calgary, Alberta, Canada.
(B. S., New Mexico School of Mines, 1909; E. M., 1910.)
Student, 1907-1910. From Burro Mountains, New Mexico. Surveyor with Mildon & Russell, Nacozari, Sonora, Mexico, 1910; General engineering work, Hermosillo, Sonora, Mexico, 1911; Mining Engineer, Portland, Oregon, 1911; Assistant superintendent, Norton Griffiths Steel Construction Company of London, England, with headquarters at Vancouver, British Columbia, Canada, 1912; Superintendent, same company, with headquarters at Calgary, Alberta, Canada, 1912—.

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†Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

JAMES FIELDING BERRY Angangueo, Michiocan, Mexico.
Student, 1904-1905. From Socorro, New Mexico. Assayer, American Smelting & Refining Company, Aguascalientes, Mexico, 1905; Assayer, City of Mexico, Mexico, 1906-1907; Chemist, Cia Metalurgica y Refinadora del Pacificio, Fundicion, Sonora, Mexico, 1908; Assistant mine superintendent, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1909—.

LOUIS AUGUST BERTRAND Upland, Nebraska.
Student, 1895-1896. From Conway, Iowa. Student, Ecole Professionalla de l'East, Nancy, Lorraine, 1890-1894. Instructor in Mathematics and French, New Mexico School of Mines, 1895-1896; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and surveyor, Consolidated Kansas City Smelting & Refining Company, Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Mine superintendent, Cia. Minera de Penoles, Mapimi, Durango, Mexico, 1901-1903; Farming in Nebraska, 1903—.

HERBERT F. BISHOP
Entered, 1914, from Faywood, New Mexico. Freshman class.

H. LAWRENCE BROWN Los Angeles, California.
Student, 1903-1905. From Chicago, Illinois. Positions: Assayer, Ernestine Mining Company, Mogollon, New Mexico; Engineer, Cia Concheno Beneficiador, Mexico; Mill superintendent, Milwaukee Gold Extraction Company, Phillipsburg, Montana; Engineer, Transvaal Copper Company, Sonora, Mexico; Manager, Morning Star Mining Company, Ophir, Colorado; Manager, San Carlos Mining Company, Sonora, Mexico; Manager of six properties and consulting engineer, Cobalt, Ontario, Canada; Superintendent, Haile Gold Mine, Kershaw, South Carolina; Exploration work in Venezuela, South America; Mill superintendent, National Mining Company, National, Nevada; at present, mining engineer with the American Metal Company with headquarters at Los Angeles, California.

CHAUNCEY E. BUTLER*
Student, 1893-1894, from Kelly, New Mexico. Assayer, Cibolo Creek Mill & Mining Company, San Francisco, California, 1896; Assayer and furnace superintendent, La Compania Minera Lustre, Magistral, Durango, Mexico, 1897-1898; Chemist and assayer, United Verde Copper Company, Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Company, and Jenny Lind and Maple Mining Company, Dedrich, California, 1903.

PHILLIP A. CAMPREDON Metcalf, Arizona.
(B. S. in Metallurgical Engineering, New Mexico School of Mines, 1914.)
Assayer for Shannon Copper Company, Metcalf, Arizona.

*Deceased.

R. HARLAND CASE Deming, New Mexico.

Student, 1902-1905, from Cerrillos, New Mexico. Chemist, Compania Metalurgica de Torreon, Coahuila, Mexico, 1905-1906; Assistant superintendent, Bonanza Mines, Zacatecas, Mexico, 1906; Assistant manager, Stephenson-Bennett Mining and Milling Company, Organ, New Mexico, 1906-1907; Consulting engineer, Western Mining, Milling & Leasing Company, Colorado Springs, Colorado, 1907-1908; Mining engineer, Deming, New Mexico.

LEO CASEY

Entered, 1914, from Quemado, New Mexico. Academic Department.

EDWARD C. CHAMNEY Minnehaha, Arizona.

Student, 1899-1900, from Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-1901; Assayer, Oro Mining Company, Minnehaha, Arizona, 1901.

VIVIAN V. CLARK Seattle, Washington.

Student, 1896-1898, from Kelly New Mexico. Assayer, Bland Mining Company, Bland, New Mexico, 1898-1899; Superintendent, Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine operator, Albuquerque, New Mexico, 1902; Manager Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903-1908; Consulting Engineer, Consolidated Exploration Mines Company of New York, and allied syndicates, 1909-1910; President, Northern Engineering Company, Seattle, Washington, 1910-1912; President, Clark Mining Machinery Company, successors to Northern Engineering Company, Seattle, Washington, 1912—.

DAVID JOSHUE CLOYD Golconda, Arizona

Student, 1899-1900. From Decatur, Illinois. Chemist and assayer, Wardman's Assay Office, Aguascalientes, Mexico, 1900-1906; Assistant superintendent, Cia. Minera del Tiro General, and assistant superintendent, Cia. del Ferrocarril Central de Potosi, Charcas, San Luis Potosi, Mexico, 1906-1908; Assayer and chemist, Dailey, Wisner & Company, Torreon, Coahuila, Mexico, 1908; Chief assayer and chemist, Mazapil Copper Company, Saltillo plant, Saltillo, Coahuila, Mexico, 1911-13; Shift boss in the Concentrating Mill, Union Basin Mining Company, Golconda, Arizona, 1915—.

SAMUEL COCKERILL Indianapolis, Indiana.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-1906. From North Fork, Virginia. Post-graduate engineering course, Allis-Chalmers Company, 1907-1908; Milwaukee Coke and Gas Company, Milwaukee, Wisconsin, 1908-1910; Citizens Gas Company, Indianapolis, Indiana, 1910—.

LEON DOMINION New York, New York.

(B. A., Roberts College, Constantinople, 1896; C. I. M., Mining School, University of Liege, 1900.)

Graduate student, 1903-1904. From Constantinople, Turkey. Assist-

tant, United States Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-1904; Engineer, Victor Fuel & Iron Company, Denver, Colorado, 1904-1906; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-1907; Consulting Engineer, Mexico City, Mexico, 1908-1909; Consulting engineer, New York City, 1910. Present address unknown.

LLOYD JESSE DRAKE

Entered, 1913, from Albuquerque, New Mexico. Academic Department.

ROBERT CASIANO EATON*

Student, 1893-1894. From Socorro, New Mexico. Sampling mill foreman, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1894-1898; Superintendent, Muriedas Smelting Works, Xichu, Guanajuato, Mexico, 1898; Superintendent, Poz del Carmen Ferrocarril, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager, Nuevo Cinco Senores Mining and Milling Company, Camanja, Jalisco, Mexico, 1902-1904; Independent assayer and ore buyer, Leon, Guanajuato, Mexico, 1904-1910.

ALEXANDER WALTER EDELEN — Mexico City, Mexico.

Student, 1905-1906. From Baltimore, Maryland. Assistant superintendent, Elkton Consolidated Mining & Milling Company, Elkton, Colorado, 1906-1907; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1907-1908; Mine superintendent, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1909—.

ALEDRSON BURGHR EVERHEART

Entered, 1912, from Bells, Texas. Special. Assayer, San Xavier Mine, Tucson, Arizona, 1913—.

THADDEUS BELL EVERHEART — Socorro, New Mexico.

Student, 1905-1907. From Bells, Texas. Assayer and surveyor, Pereguina Mining and Milling Company, Guanajueto, Mexico, 1907-1908; Mill superintendent, Las Animas Mining and Milling Company, Pueblo Nuevo, Durango, Mexico, 1908-1910; Mining, Chloride, New Mexico, 1911-1913; Mining Engineer, Socorro, New Mexico, 1914—.

LEOPOLD E. FLEISSNER — Milwaukee, Wisconsin.

(B. S., E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1910-1912. From Manistee, Michigan. Engineer, Sterling Engineering & Construction Company, Milwaukee, Wisconsin, 1912-1913; Engineer, Ray Consolidated Copper Company, Ray, Arizona, 1913—.

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*Deceased.

HOWARD M. GIBSON
Entered, 1914, from Farmington, New Mexico. Academic Department.

HARRY THORWALD GOODJOHN Torreon, Coahuila, Mexico.
Student, 1902-1903. From Pittsburg, Texas. Assayer, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1903-1906; Chief Chemist, Minera de Penoles Company, Mapimi, Durango, Mexico, 1906; Chemist and metallurgist, Cia. Minera, Fundidora, y Afinadora, Monterey, Mexico, 1907-1908; Chief Chemist, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1909—.

SAMUEL JAMES GORMLEY West Jordan, Utah.
Student, 1895-1896. From Mt. Vernon, Iowa. Assistant professor of Engineering, New Mexico School of Mines, 1895-1896; Assistant assayer, Anaconda Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist, same company, 1900-1902; Superintendent of sampling works, Washoe Smelting Company, Anaconda, Montana, 1902-1906; Smelter superintendent, Bingham Copper & Gold Mining Company, West Jordan, Utah, 1906.

JOHN B. GUNTER
Entered, 1914, from Belen, New Mexico. Special student.

DONALD EUGENE HAGAMAN
Entered, 1915, from San Diego, California. Freshman class.

EDWIN CLARENCE HAMMEL
Entered, 1912, from Socorro, New Mexico. Academic Department.

HENRY HAYS
Entered, 1914, from Estancia, New Mexico. Academic Department.

RUE N. HINES*
(B. S., New Mexico School of Mines, 1907.)
Student, 1904-1907. From Socorro, New Mexico. Superintendent West Coast Mining & Smelting Company, Mocorito, Sinaloa, Mexico, 1907-1909; Locating and developing prospects in Arispe District, Sonora, Mexico, 1910; Secretary, First Mortgage & Security Company, El Paso, Texas, 1911.

INNOKENTY J. HLEBNIKOFF Santa Barbara, Cal.
Student, 1912-1914, from Blagoveshensk, Russia. Special.

EDMUND NORRIS HOBART Morenci, Arizona.
(B. S., New Mexico School of Mines, 1910.)
Student, 1906-1908, 1909-1910. From Clifton, Arizona. Chemist, Socorro Mines Company, 1909; Chief sampleman, Shannan Copper Company, Clifton, Arizona, 1910-1911; Assistant surveyor, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1911;

*Deceased.

Resident engineer, Capistante Mines Group, Mazapil Copper Company, Limited, Concepcion del Oro, Zacatecas, Mexico, 1912; Chief engineer, Charcas Unit, American Smelting & Refining Company, Charcas, San Luis Potosi, Mexico, 1913-1914; Mining engineer, Phelphs-Dodge Company, Monenci, Arizona, 1914—.

ANTON HOGWALL Nogal, New Mexico.

Student, 1898-1899. From White Oaks, New Mexico. Assayer Buckeye Mining Company, Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Company, and Helen Rae Mining Company, White Oaks, New Mexico, 1901; American Gold Mining Company, Nogal, New Mexico, 1902.

CARL JOHN HOMME Glendale, Oregon

(A. B., St. Olaf College.)

Graduate student, 1899-1900. From Wittenburg, Wisconsin. Assayer and chemist, Candelaria Mining Company, El Paso, Texas, 1900-1901; Assistant superintendent, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902; Assayer, Glendale, Oregon, 1909-1913; Cooston, Oregon, 1914—.

WILLIAM ELIAS HOMME Glendale, Oregon.

(A. B., St. Olaf, College.)

Graduate student, 1902-1903. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. HOWELL Santa Fe, New Mexico.

Student, 1900-1905. From Socorro, New Mexico. Civil Engineer on railway from Acapulco, Mexico, 1906, 1907; Civil engineer, Mexican Central R. R., 1907-1912; Assistant to state engineer, Santa Fe, New Mexico, 1913—.

HARRY J. HUBBARD*

(B. S., New Mexico School of Mines, 1906.)

Student, 1905-1906. From Bisbee, Arizona. Mine foreman, Navidad Mine of Greene Gold-Silver Company, Concheno, Chihuahua, Mexico, 1906; Chemist, same company, 1906; Assistant mill superintendent, Sahuanycan Mining Company, Sahuanycan, Chihuahua, Mexico, 1906; Machine drill foreman, Sirena Mine, Guanajuato, Mexico, 1907; Shift boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan and associates in southwestern states of Mexico, 1907; Tramway superintendent, Bonanza Mine, Zacatecas, Mexico, 1908; Foreman, Butters Divisavero Mines, Jocoro, San Salvador, Central America, 1909-1910; Superintendent, Las Animas Mining Company, Hermosilla, Sonora, Mexico, 1910; Foreman, Minas del Tajo, Rosario, Sinaloa, Mexico, 1911—.

*Deceased.

JOHN AUGUST HUNTER Denver, Colorado.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro, New Mexico. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-1904; Chemist and metallurgist, American Smelting & Refining Company, Aguascalientes, Mexico, 1904-1908; Metallurgist, Congress Mining Company, Congress, Arizona, 1909-1910; Assayer, Los Angeles, California, 1910-1911; Engineer, Pioneer Mining Company, Tucson, Arizona, 1911-1912; Engineer, American Zinc Ore Separator Company, Denver, Colorado, 1912-1914; Mining engineer, Socorro, New Mexico, 1914—.

FRANK A. JOHNSTON New Bloomfield, Pa.

Entered, 1911, from New Bloomfield, Pennsylvania. Secured B. S. degree in Civil Engineering, 1913.

PHILLIP R. JONES

Entered, 1914, from Albuquerque, New Mexico. Freshman class.

CHARLES THAYER LINCOLN New York, New York.

(B. S., Massachusetts Institute of Technology, 1901.)

Graduate student, 1902-1903. From Boston, Massachusetts. Chemist, Bell Telephone Company, 1901-1902; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-1903; Acting professor, same, 1903-1904; Instructor in Chemistry, Iowa State University, Iowa City, Iowa, 1904-1905; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-1907; Chemist, Arbuckle Brothers Sugar Refinery, Brooklyn, New York, 1907-1909; Chemist, United States Custom Service, New York, 1910—.

FRANCIS CHURCH LINCOLN Reno, Nevada.

(B. S., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1903.)

Assayer, San Bernardino Mining Company, 1900; Chemist, Butterfly Terrible Gold Mining Company, 1900-1901; Professor of Metallurgy, New Mexico School of Mines, 1902-1904; Assistant superintendent, Ruby Gold & Copper Company, Ortiz, Senora, Mexico, 1904; General manager, Arizona Gold & Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907-1910; Mining engineer, New York, New York, 1911-1914; Head and professor of mining and metallurgy, MacKay School of Mines, University of Nevada.

RAFAEL LOPEZ

Entered, 1912, from Socorro, New Mexico. Academic Department.

HORACE T. LYONS Globe, Arizona.

(B. S. in Mining Engineering, New Mexico School of Mines, 1913.)

Mining engineer at Miami, Arizona, 1913-1914; Now at Globe, Arizona in moving picture theatre.

N. L. MACDONALD
Entered, 1914, from Los Angeles, California. Freshman class.

HARRY C. MAGOON Chicago, Illinois.
Student, 1899-1900. From Chicago, Illinois. Engineer, Illinois Steel Company, Chicago, Illinois, 1911.

JOHN B. McDONALD
Entered, 1914, from Albuquerque, New Mexico. Academic Department.

FRANK MALOIT Lordsburg, New Mexico.
(B. S. in Mining Engineering, New Mexico School of Mines, 1914.)
Engineer for the 85 Mine, Lordsburg, New Mexico, 1914—.

CONRAD C. MEYER New York, New York.
(A. B., New York University; M. D., Bellevue Hospital.)
Graduate student, 1900-1901. From New York, New York.

HARRY A. MILLER
Entered, 1914, from Malone, New York. Special student.

DANIEL M. MILLER Lake Valley, New Mexico.
(B. S., New Mexico School of Mines, 1909.)
Student, 1906-1909. From Lake Valley, New Mexico.

TARVER MONTGONERY Santa Ana, California.
Student, 1899-1900. From Santa Ana, California. County surveyor, Orange county, California, 1900-1901; Assistant engineer, Temescal Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles & Salt Lake Railroad Company, 1901-1902; Assistant engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

GENOVEVO MONTOYA
Entered, 1914, from Kelly, New Mexico. Academic Department.

EARLE GIBBON MORGAN Guadalajara, Jalisco, Mexico.
(E. M., New Mexico School of Mines, 1911.)
Student, 1907-1908, 1910-1911. From Lansdowne, Pennsylvania. Pennsylvania State College, 1908-1910. Engineer, Socorro Mines Company, Mogollon, New Mexico, 1911-1912; Assistant engineer, same company, Guadalajara, Jalisco, Mexico, 1912—.

ERLE D. MORTON Los Angeles, California.
(E. M. in Mining Geology, New Mexico School of Mines, 1909.)
Student, 1903-1905, 1908-1909. From Los Angeles, California. Assistant superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-1906; Washington University, 1906-1907; Mine examiner, Los Angeles, California, 1907-1908; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908; Mine superintendent, Arizona & Nevada Copper Company, Luning, Nevada, 1909-1910; Mining engineer, Los Angeles, California, 1910; Chief engineer, Lone Moun-

tain Tunnel Company, Superior, Montana, 1911-1912; with Braun Corporation, Los Angeles, California, 1912-1913; Assistant superintendent, Elko-Prince Mining, Gold Circle, Elko County, Nevada.

WILLIAM FREDERICK MURRAY — Delagua, Colorado.
Student, 1904-1906. From Raton, New Mexico. In chief engineer's office, Victor Fuel Company, Denver, 1906-1907; Assistant engineer, Victor Fuel Company, 1907-1908; Assistant to chief and traveling engineer, Victor Fuel Company and Colorado & Southern Railway Company, 1908; Assistant engineer, Hastings Mine, Victor Fuel Company, Hastings, Colorado, 1909-1910; Superintendent, Cass Mine, Victor American Fuel Company, Delague, Colorado, 1910-1913; Assistant general superintendent, Colorado Division, the Victor American Fuel Company, Trinidad, Colorado, 1913—.

MARTIN J. O'BOYLE — Mogollon, New Mexico.
(B. S. in Mining Engineering, New Mexico School of Mines, 1914.)
Mining engineer for the Socorro Mines Company, Mogollon, New Mexico, 1914—.

PATRICK J. O'CARROLL*
(A. B., University of Dublin, Ireland.)
Graduate student, 1898-1899. From Dublin, Ireland. Mine operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN*
(B. S., New Mexico School of Mines, 1896.)
Student, 1895-1896. From Butte, Montana. Assistant superintendent, Philadelphia Mines, Butte, Montana, 1896-1897.

JUAN PALISSO — Mexico.
Student, 1903-1904. From Barcelona, Spain. Mining engineer, Mexico.

ORESTE PERAGALLO — Tepec, Mexico.
(E. M., New Mexico School of Mines, 1908.)
Student, 1907-1908. From Ciudad Juarez, Chihuahua, Mexico. Mining engineer, El Paso, Texas, 1908-1910; Graduate student, New Mexico School of Mines, 1910-1911; Mining engineer, El Paso, Texas, 1911-1912; Chemist, Tepec, Mexico, 1912-1914; Mining engineer, San Diego, California, 1915—.

FOUNT RAY — Italy, Texas.
Student, 1901-1902. From Waxahachie, Texas. General manager, Lena Mining & Concentrating Company, Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902-1912; Real estate business, 1912—.

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*Deceased.

DANIEL FRANCIS RECKHART

Entered, 1913, from El Paso, Texas. Freshman class.

ALBERT BRONSON RICHMOND Tucson, Arizona.

Student, 1900-1901. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gabilan, Sonora, Mexico, 1901-1902; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and metallurgist, Patagonia, Arizona; General manager, Mansfield Mining & Smelting Company, Patagonia, Arizona, 1908; Consulting engineer, Tucson, Arizona, 1909; Field Engineer, Mines Company of America with headquarters at Tucson, Arizona, 1910—.

DELL FRANK RIDDELL Parral, Chihuahua, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; E. M., New Mexico School of Mines, 1905.)

Graduate student, 1903-1905. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, Sioux Falls, South Dakota, 1901-1903; Instructor in chemistry, New Mexico School of Mines, 1903-1904; Acting professor of assaying, same, 1904-1905; Holder of Allis-Chalmers Scholarship, 1905-1906; Engineer, Universal Pump & Manufacturing Company, Kansas City, Missouri, 1906-1907; Superintendent, Benito Juarez Mine, Parral, Chihuahua, Mexico, 1907-1908; Consulting engineer and acting superintendent, Providentia Mines Company, Parral, Chihuahua, Mexico, 1908.

SOREN RINGLUND

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1910-1912. From Ceresco, Nebraska. Engineer, Empire Zinc Company, Kelly, New Mexico, 1912—.

ORLANDO DOUGLAS ROBBINS Depue, Illinois.

(B. S. and E. M., New Mexico School of Mines, 1909.)

Student, 1905-1909. From Louisville, Kentucky. Chemist, El Chino Copper Company, Santa Rita, New Mexico, 1909-1910; Mill superintendent, Germania Mining Company, Springdale, Washington, 1910; Chief sampler, Inspiration Copper Company, Globe, Arizona, 1910; Engineer, United States Steel Company, Depue, Illinois, 1911-1913; Chief of ore and testing department of Mineral Point Zinc Company, Depue, Illinois, 1914—.

MANUEL A. SANCHEZ

Entered, 1914, from Mora, New Mexico. Sophomore class, Civil Engineering.

CHARLES S. SHAMEL Seattle, Washington.

(B. S., M. S., University of Illinois; LL. B., University of Michigan; A. M., Ph. D., Columbia University.)

Graduate student, 1901-1902. Mining lawyer, Seattle, Washington.

JAMES AVERY SMITH Miami, Arizona.

Entered, 1908, from Socorro, New Mexico. B. S. degree in Metallurgical Engineering, 1913; Assayer and sampler, Inspiration Copper Company, Miami, Arizona.

IRVING L. SMITH

Entered, 1913, from Socorro, New Mexico. Academic Department.

OLIVER RUSSELL SMITH Naches, Washington.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1908; C. E., New Mexico School of Mines, 1902.)

Graduate student, 1898-1901. From Manhattan, Kansas. B. S. in Civil Engineering, New Mexico School of Mines, 1902; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1901; Instructor in Engineering and Drawing, same, 1901-1902; Assistant professor in Engineering and Drawing, same, 1902-1903; Assistant surveyor, U. S. General Land Office, 1902; City engineer, Socorro, New Mexico, 1902; Deputy mineral surveyor, U. S. General Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1903-1907; Civil engineer, Santa Fe Railway, San Bernardino, California, 1907-1908; Engineer United States Reclamation Service, Zillah, Washington, 1908-1910.

MAURICE SPELLMAN

Entered, 1914, from Ambay, California. Academic Department.

JACOB STAPLETON

Entered, 1912, from Socorro, New Mexico. Academic Department.

PAUL E. M. STEIN El Paso, Texas.

(B. S., New Mexico School of Mines, 1911; E. M. in Mining Geology, 1912.)

Student, 1907-1912. From Davenport, Iowa. Assistant engineer, Socorro Mines Company, Mogollon, New Mexico, 1912; Chemist, El Paso plant, Kansas City Consolidated Smelting and Mining Company, El Paso, Texas, 1912—.

EDWARD J. STEVENS

Entered, 1914, from Pinos Altos, New Mexico. Academic Department.

WILLIAM CARLOS STEVENSON*

Student, 1900-1901. From Hillsboro, Ohio. General manager, Mining Corporation. Albuquerque. New Mexico, 1901.

KARL AKSEL STRAND Bisbee, Arizona.

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1906-1912. From Socorro, New Mexico. Ore classifier, Utah Copper Company, Garfield, Utah, 1912; Draughtsman, same, 1912.

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*Deceased.

JOHN STUPPE Torreon, Coahuila, Mexico.

Student, 1903-1904. From El Paso, Texas. Accounting department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1904.

LEO RICHARD AUGUST SUPPAN St. Louis, Missouri.

(B. S. in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)

Student, 1895-1896. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-1897; Graduate student, Johns Hopkins University, Baltimore, Maryland, 1897-1898; Professor of Chemistry, Marine-Sims College, St. Louis, Missouri, 1898—.

ALFRED L. THELIN, JR.

Entered, 1914, from Albuquerque, New Mexico. Academic Department.

OTTO JOSEPH TUSCHKA Monterey, Nuevo Leon, Mexico.

(E. M. in Metallurgical Engineering, New Mexico School of Mines, 1897.)

Student, 1893-1897. From Socorro, New Mexico. Assayer and chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-1898; Graduate student, New Mexico School of Mines, 1898-1899; Assistant sampling mill foreman and chemist, Guggenheim Smelting & Refining Company, Monterey and Aguascalientes, Mexico, 1899-1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chief chemist, Compania Minera, Fundidora, y Afinadora "Monterey," Monterey, Nuevo Leon, Mexico, 1900—.

LAURENCE P. WELD Thompson, Nevada.

(B. S. and E. M., New Mexico School of Mines, 1912.)

Student, 1908-1912. From Rochester, New York. Concentrator man, Original Amador Mines Company, Amador City, California, 1912-1913; Assistant engineer and chemist, same company, 1913; Smelter electrician, Mason Valley Mines Company, Thompson, Nevada, 1913—.

MILTON BENHAM WESCOTT Monterey, Nuevo Leon, Mexico.

Student, 1904-1905. From Chicago, Illinois. Engineering corps. Santa Fe Railway, 1905; Assistant county surveyor, El Paso county, Texas, 1906-1907; Assistant engineer, Monterey Railway, Light and Power Company, Monterey, Nuevo Leon, Mexico, 1907; Assistant engineer, Monterey Water-works and Sewer Company, Monterey, Nuevo Leon, Mexico, 1907, 1908; Resident engineer, same, 1908—.

GEORGE C. WHEELOCK

Entered, 1914, from Mogollon, New Mexico. Freshman class.

PATRICK ANDREW WICKHAM Maris, Chihuahua, Mexico.

Student, 1893-1894. From Socorro, New Mexico. Mechanical engineer, Buckeye Mining Company and Albemarle Mining Company, Bland, New Mexico, 1898-1899; Mechanical engineer, Mt. Beauty Min-

ing Company, Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Company, Cripple Creek, Colorado, 1900-1901; Foreman, Guggenheim Exploration Company, Minas Tecolotes, Santa Barbara, Chihuahua, Mexico, 1901-1902; Foreman, Independence Consolidated Gold Mining Company, Cripple Creek, Colorado, 1902-1904; Manager, Consuelo & Esperanza Gold Mining Companies, Dolores, Mexico, 1904-1906; Assistant superintendent, Kelvin-Calumet Copper Mining Company, Ray, Arizona, 1907-1908; Superintendent La Cienega Mining Company, Maris, Chihuahua, Mexico, 1909—.

WAKELEY A. WILLIAMS Grand Forks, British Columbia, Canada.
Student, 1893-1894. From Council Bluffs, Iowa. Assistant superintendent, Granby Consolidated Mining, Smelting, and Power Company, Limited, Grand Forks, British Columbia, Canada, 1898. At present superintendent of same.

CHARLES FRANCIS WILLIAMS
Entered, 1914, from Mansfield, Ohio. Freshman class.

SAMUEL H. WILLISTON
Entered, 1914, from Chicago, Illinois. Freshman class.

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ANNUAL REGISTER

OF THE

NEW MEXICO STATE SCHOOL OF MINES

SOCORRO, N. M.

1915-1916

With Announcements for 1916-1917

MAIN BUILDING

ANNUAL REGISTER

OF THE

NEW MEXICO STATE SCHOOL OF MINES

SOCORRO, N. M.

1915-1916

With Announcements for 1916-1917

ALBRIGHT & ANDERSON
PRINTERS, BINDERS
ALBUQUERQUE

CALENDAR.

1916.

First Semester:

September 18, Monday—Registration of students.

September 19, Tuesday—Class work begins.

November 30, Thursday—Thanksgiving.

December 22, Friday, 4 P. M.—Holiday recess begins.

1917.

January 2, Tuesday—Work resumed.

January 24, 25, 26—Examinations.

Second Semester:

January 29, Monday—Second semester begins.

February 22, Washington's Birthday—Holiday.

May 21, 22, 23—Final Examinations.

May 24, Thursday, 8:30 P. M.—Commencement.

BOARD OF REGENTS.

His Excellency, William C. McDonald, *Governor of New Mexico, ex-officio* .... Santa Fe
Hon. Alvan N. White, *Superintendent of Public Instruction, ex-officio* .... Santa Fe
A. C. Torres .... Socorro
John McIntyre .... San Antonio
W. M. Borrowdale .... Magdalena
J. E. Smith .... Socorro
W. R. Morley .... Datil

OFFICERS OF THE BOARD.

A. C. Torres .... President
John McIntyre .... Secretary and Treasurer
Mrs. Blanche E. Reed .... Clerk of Board

FACULTY.

FAYETTE ALEXANDER JONES........................*President*

C. E., E. M., State School of Mines, University of Missouri, 1892; Engineer, Union Mining Company, Phoenix, Ariz., 1893; Topographic Engineer for sewer system, Independence, Mo., 1894; Chief to topographic surveys, Isthmus of Tehuantepec, 1894-5; Mining Engineer, Phoenix, Ariz., 1896; U. S. Assayer at Kansas city, 1896-8; Chemist of Missouri State Geological Survey, 1897-8; President New Mexico School of Mines, 1898-02; LL. D., Nashville College of Law, Tenn., 1903; Field Assistant U. S. Geological Survey, 1901-6; Member New Mexico Board of Exposition Managers to International Exposition at St. Louis and chairman of Committee on Mines and Mining, 1903-4; Statistician of U. S. mint for precious metals of New Mexico, 1904-6; Geologist, Colorado, Columbus & Mexican Railway, 1908-9; Chief of expedition and mineralogist to Island Tiburon in Gulf of California, 1909; Mining Engineer, Grants Pass, Oregon, 1910-11; Chief of geological and mineralogical explorations through central British Columbia along proposed line of Grand Trunk Pacific Railway, 1911-12; re-elected President New Mexico State School of Mines, 1913—; Author, Mem Am. Inst. of Mining Engineers, etc.

GUSTAVUS EDWIN ANDERSON.......................
.....................*Professor of Geology and Mineralogy*

S. B. in Geology, University of Chicago, 1905; A. M. Columbia University, 1906; Assistant in Geology, Columbia University, 1905-06; University Fellow in Geology, Columbia University, 1906-07; Professor of Geology, Imperial Mining College, Wuchang, China, 1907-09; Geologist for the Han Yang Iron Works, Han Yang, China, 1908-09; Associate Professor of Geology, Pennsylvania State College, 1909-1911; in charge of field work on the Belle Fonte Quadrangle, State College, Pa., 1908-09; Professor of Geology and Mineralogy, New Mexico State School of Mines since 1911.

THOMAS CALVIN MACKAY....*Professor of Physics, Mathematics*

A. B., Dalhousie University, 1893; Principal of Baddeck Academy, 1893-94; Principal of Parrsboro High School, 1894-96; Graduate student at Dalhousie University, 1896-98; A. M. at Dalhousie, 1898; A. M. at Harvard, 1899; Assistant in Physics at Harvard University, 1899-1900; Austin Teaching Fellow at Harvard, 1900-1901; Assistant at Harvard and Radcliffe, 1901-04; Ph. D. at Harvard, 1903; Instructor in Physics at the University of California, 1904-09; Demonstrator in Physics at Dalhousie University, 1909-10; Professor of Physics at Mt. Allison University, 1910-11; Professor of Physics and Mathematics at the New Mexico State School of Mines, 1911—; Author of a text-book on physical measurements and of various papers on physical subjects.

VIGGO EMMANUAL HANSON ....
.....................*Professor of Mechanical Engineering*

B. S., State University of South Dakota, 1910; on erecting floor, Blake Knowles Pump Works, East Cambridge, Mass., 1910-11; Draftsman, Blake Knowles Pump Works, East Cambridge, Mass., 1911-12; Assistant Professor of Civil Engineering, New Mexico State School of Mines, 1912-14; Professor of Mechanical Engineering, New Mexico State School of Mines, 1914—.

ALEXIS XAVIER ILLINSKI..............*Professor of Chemistry*

B. S. in Chemistry and Metallurgy, School of Mines and Metallurgy, University of Missouri, 1909; Superintendent of Underground Diamond Drills, Federal Lead Company, Flat River, Missouri, 1906-7; Superintendent of Canvas Plant, Federal Lead Company, Flat River, Missouri, 1907-8; Chemist, Missouri Geological Survey, Rolla, Missouri, 1909-1912; Instructor in Metallurgy and Ore Dressing, School of Mines and Metallurgy, Rolla, Missouri, 1912-14; Experimental Research Station, School of Mines and Metallurgy, Rolla, Missouri, 1914-15; Professor of Chemistry, New Mexico State School of Mines, 1915—.

ARTHUR WILLIAM FAHRENWALD.......................
.......*Professor of Mining and Metallurgical Engineering*

Homestake Mining Company, Lead, South Dakota, 1912-13; B. S. South Dakota State School of Mines, 1914; Mining Engineer, Marquette Portland Cement Mfg. Co.; La Salle, Ill., remainder of 1914 and in 1915; on flotation, Butte and Superior Copper Co., Butte, Montana, 1915; Metallurgical Engineer, South Dakota School of Mines, 1915; Professor of Mining and Metallurgical Engineering, New Mexico State School of Mines, 1915—.

EDWARD D. KINGMAN...........*Professor of Civil Engineering*

Framingham Academy; Ph. D. Yale University, S. S. S. 1907; Instrumentman, Div. No. 10, Pennsylvania Railroad 1905-8, ad interim; U. S. Reclamation Service, Tieton project, State of Washington, April to October, 1908; Municipal Engineering, Seattle, Washington; Superintenent of Reconstruction of the lines of the Seattle Electric Company, 1909; Municipal Engineering, sewers, pavements, etc., Everett, Washington, 1910; Field Engineer of topographic surveys, Kuhn projects, California, 1911; Michigan Agricultural College, instructor in railway, hydraulic, municipal and highway engineering, 1911-1913; Drainage Engineer U. S. Department of Agriculture short time in 1913; Draftsman, etc., for Michigan State Highway Commission 1913; Assistant Prof. of Railway Engineering, University of Wisconsin and office engineer Wisconsin State Highway Commission 1913-1915; Engineer on valuation of Boston and Albany railroad, 1915-16; Elected Prof. of Civil Engineering, New Mexico State School of Mines 1916—; Associate Member Am. Soc. C. E.; Yale Engineering Association; Wisconsin Soc. Engrs. etc.

JOHN BUCHANAN GUNTER......*Principal Academic Department*

B. Pd., New Mexico Normal School at Silver City, 1911; Principal of Public School, San Marcial, N. M., 1911-1912; Instructor in New Mexico Normal School (summer sessions), 1911 and 1913; M. Pd., New Mexico Normal at Silver City, 1913; Superintendent of Public Schools at Belen, N. M., 1912-1914; Principal Academic Department, New Mexico State School of Mines, 1914—.

MANUEL A. SANCHEZ...................*Instructor in Spanish*

P. A. MARCELLINO..................*Instructor in Band Music*

MRS. BLANCHE E. REED...............*Registrar and Librarian*

NEW MEXICO
STATE SCHOOL OF MINES

HISTORICAL SKETCH.

The New Mexico State School of Mines was founded by Act of the Legislature of 1889. The Act provided for the support of the school by an annual tax of one-fifth of a mill on all taxable property.

Under an Act of the Legislature, approved February 28, 1891, a board of trustees was appointed. Organization was effected and immediate steps were taken towards the erection of necessary buildings. In the same year a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892 a circular of information regarding the New Mexico School of Mines at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims of the institution were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made to enable the School of Mines to be organized in accordance with the policy outlined by the Act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land fifty thousand acres for its support and maintenance. From this source of revenue the School has already received more than $20,000.

In 1899 the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901 the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grants of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903 the Thirty-fifth General Assembly raised the millage to forty-five one-hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the school over that of the previous year.

Since 1903 the appropriation for the support and maintenance of the School of Mines has been increased at each session of the General Assembly. At the first session of the State Legislature the appropriation was raised to $22,500 a year.

The Second State Legislature of 1915 provided the additional fund of $20,000 for machinery and metallurgical equipment, which sum is now being spent to carry out the purpose intended.

By the terms of the Enabling Act under which New Mexico was admitted to statehood, the School of Mines becomes possessed of an additional 150,000 acres of land. Most of this land has now been selected and will soon become the source of a very considerable revenue to the institution.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the Act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this Act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agricultural, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this Act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and 10 of this Act. Said trustees and their successors in office shall

constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this Act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said School require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico State School of Mines is located at Socorro, the county seat of Socorro County, on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the valley of the Rio Grande at the foot of the Socorro range of mountains at an elevation of 4,600 feet above the level of the sea. The surrounding scenery is diversified by plains, valleys, mesas, hills, and mountains. The climate of the locality is pre-eminently pleasant and healthful, and has long attracted health-seekers who would escape the rigors of less favored localities. The air is exceedingly dry and the temperature is mild and equable. Socorro's public water supply comes from warm springs that issue from Socorro mountain three miles

away. The water is famed for its purity and has always been an attraction to visitors and residents.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the school in those branches which usually require tedious excursions from most other schools. Almost the entire geological column is here exposed.

The New Mexico State School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Mogollon, Kelly, White Oaks, San Pedro, Hillsboro, Lordsburg, Fierro, Silver City, Pinos Altos, Santa Rita, Burro mountains, Los Cerrillos, Dawson, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, lixivation, cyaniding, and other metallurgical processes.

A number of mines of various kinds, smelters, irrigation systems, and other engineering works are accessible to the School. Within a few hours ride by rail are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the oldest worked lodes in Ameirca are in this region. Gold and turquoise were first noted by the *conquistadores* in 1540-2 by the celebrated expedition of Francisco Vasquez de Coronado, when in search of the Gran Quivira, one of the seven cities of Cibola. The first modern discovery of gold in New Mexico was made at the base of the Ortiz mountains, in Santa Fe county, in the year 1828. The first copper mined west of the Mississippi river was at Santa Rita in Grant county, in 1800. The metal from these copper mines was transported on the backs of burros to Mexico City and thence sent to the royal mint of Spain to be made into coin. The Chino Copper Company now operates these

celebrated mines. Among the great wonders of the West are the ancient turquoise working at Mount Chalchihuitl near Los Cerrillos. An ancient lode mine, known as *Mina del Tierra,* is situated near the ancient turquoise workings. Verily, New Mexico is the birthplace of American mining.

The history of modern mining schools shows that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico State School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of the world.

The School is a state institution. It was established primarily to promote the development of the mineral resources of New Mexico and to provide facilities for the young men of the state to secure a practical education in all departments of mining. Naturally, however, the institution's field of usefulness has steadily grown broader. Not only New Mexico but also other parts of the southwest have felt its influence through its graduates in the development of the mining industries of this great region. Moreover, a considerable number of students from other parts of the country who desired to avail themselves of the peculiar advantages of this region have come to the School of Mines for the training they needed and the number of such young men is constantly increasing.

During the entire period of his training the fact is impressed upon the mind of the student that intelligent mining is a business operation capable of being put on as secure a foundation as any other; that from beginning to end it is akin to all other great business undertakings. While lucky finds will doubtless continue to be made, mining is no longer to be considered a mere lottery appealing to the gambling propensities.

During the past quarter of a century the development of the

mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines:

The unique natural surroundings of the School already described create an invigorating mining atmosphere which is entirely wanting in institutions remote from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in those technical institutions of learning where all practical branches are equally represented, singleness of purpose is a leading feature of the New Mexico State School of Mines. The concentration of energy growing out of the special method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect, under the direct supervision of his instructors, various plans and works and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work and at once necessarily acquires for his chosen profession a sympathy that is seldom attained, except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portions, which comprise about two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the

state has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made under government auspices to investigate closely the geological structure of New Mexico mountains such as have been carried out in the other Rocky Mountain states, or to study the conditions of New Mexico mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

Much of the advanced professional work of the School is of an original nature to the end that the graduates may be skilled, theoretically and practically, in the very problems which they as professional men will be called upon to solve. This work is carried on by the advanced students under the direction of the professors and involves the collection of notes, sketches, maps, and specimens, and the results of directed observations in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining and in the reduction of the ores of lead, silver, gold, copper, and zinc are so numerous that it is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply, and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, thus giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigators of the ores of iron, manganese, aluminum, cobalt, nickel, tin, and quicksilver, vanadium, and uranium, together with the beds of coal, salt, alum, building stones, mineral-paints, cement-rock, marls, etc., are directly in line with the advanced laboratory work of the School, and every student who undertakes such work is encouraged in every possible way to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico State School of Mines is vested in a Board of Regents consisting of five members appointed by the Governor of the State with the concurrence of the Senate for a term of four years. The Board of Regents elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of

the School is also made by them, as well as the selecting of a teaching staff.

By Act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of the state. The New Mexico State School of Mines, therefore, is composed of the College and the Academy.

THE COLLEGE.

Requirements for Admission.

Candidates for admission to the College are required to present a statement from some school of recognized standing certifying that they have completed and received a passing grade in the following subjects: Elementary Algebra, Plane and Solid Geometry, Physical Geography, ninth, tenth and eleventh grade English, and one year of Elementary Physics, Chemistry, and Geology. Those candidates who are unable to present such a statement may take an examination by the Principal of the Academy on any of the foregoing subjects to determine their proficiency therein. Graduation from accredited high schools of this and other states will admit the student to the College work without examination.

Registration.

No student will be allowed to register for any subject until the pre-requisites are credited to him on the school records. Therefore the student is advised not to delay either in making up any deficiencies which may exist or in obtaining from the School the credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the Bachelor's Degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time of matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the School may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students desiring to take special courses without a view to graduation may do so provided that they give evidence of proficiency in the prerequisite subjects and that their taking such courses does not interfere with the regular schedule of classes.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting, surveying, railway and engineering construction. Accordingly, curricula are offered in the following:

Curricula.

MINING ENGINEERING.
METALLURGICAL ENGINEERING.
GEOLOGICAL ENGINEERING.
CIVIL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of either of them the Bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines who have spent two years in professional work, at least one of which must have been in a position of responsibility, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one period of work in the class-room requires two periods of preparation, and therefore that one period of work in the class-room is equivalent to three periods of work in the field or in the laboratory. In the following outlined statement of curricula the number of periods per week required in the class-room and in the field or in the laboratory are given separately. The number of periods required in the field or in the laboratory represents *average* time, however, inasmuch as it is frequently

advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

Short Courses.

For the benefit of resident young men of the state short courses of a few weeks' duration will be given in prospecting, assaying, mineralogy, surveying, chemistry, mechanics, electricity, etc. Such a departure from the full college courses ought appeal to those who wish to attain greater efficiency, which will mean a corresponding increase in wages.

UNIFORM CURRICULUM FOR THE FIRST TWO YEARS.

The curriculum for the first and second years of the four courses offered at the School of Mines is the same in all respects. This arrangement is of advantage to the student, as it gives him until the beginning of the third year to determine for which of the four courses he is best fitted by inclination or aptitude.

Mathematics, physics, and chemistry are fundamental subjects for the successful engineer. For that reason the two first years of all the engineering courses are devoted to a thorough grounding in those three subjects as will be seen in the tabular statement below. Specialization does not begin until afterwards.

Excellent facilities are offered for the acquisition of a thorough knowledge of these subjects so necessary to successful engineering work both during the remainder of the course and during a professional career.

UNIFORM CURRICULUM.

FIRST YEAR.

Course Numbers		Courses.	Periods per week	
			Class	Lab'y
		First Semester		
I.	1.	Algebra	5	
I.	2.	Trigonometry (Plane)	5	
I.	3.	Analytic Geometry	3	
III.	1.	General Chemistry	5	6
VIII.	1.	Shop		6
VIII.	2.	Mechanical Drawing		6
III.	2.	Qualitative Analysis	1	9
		Second Semester		
I.	1.	Advanced Algebra	3	
I.	2.	Trigonometry (Spherical)	2	
I.	3.	Analytic Geometry	2	
III.	1.	General Chemistry	5	6
IV.	1.	General Surveying	3	4
VIII.	3.	Machine Drawing		6
VIII.	5.	Descriptive Geometry	3	
III.	2.	Qualitative Laboratory		9

UNIFORM CURRICULUM.
SECOND YEAR.

Course Numbers		Courses.	Periods per week Class	Lab'y
		First Semester		
I.	4.	Calculus	5	
II.	1.	Experimental Mechanics	3	3
III.	2.	Quantitative Analysis	1	9
IV.	2.	Mine Surveying and Mapping	2	4
IV.	2.	Railroad Surveying	2	4
V.	I.	Mineralogy	3	3
V.	2.	General Geology	2	
III.	4.	Ore Analysis		9
		Second Semester		
I.	5.	Calculus	5	
II.	2.	Heat and Light	3	3
III.	5.	Water and Fuel Analysis		6
IV.	3.	Topographical Surveying	2	4
V.	I.	Mineralogy	3	3
V.	3.	General Geology	3	
II.	3.	Electricity and Magnetism	3	3
VIII.	4.	Machine Design	2	6

MINING ENGINEERING.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business careers of the profession is kept constantly before the student. Valuing property, properly reporting propositions submitted for investment, calculating the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaption of the steam shovel and stripping methods to western metal mines are treated at considerable length.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives detailed consideration.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers		Courses.	Periods per week	
			Class	Lab'y
		First Semester		
II.	4.	Mechanics	3	
III.	5.	Ore Analysis	1	9
VIII.	6.	Strength of Materials	2	
V.	7.	Petrology	2	3
VI.	1.	Mining A.	3	3
VII.	2.	Principles of Metallurgy	3	
IV.	12	Hydraulics	3	
		Second Semester		
II.	4.	Mechanics	4	
V.	4.	Field Geology	1	3
V.	7.	Petrology	2	3
III.	6.	Fuel Analysis		3
VI.	2.	Mining B.	3	
VII.	1.	Fire Assaying	1	8
VIII.	4.	Machine Design	2	6
IV.	21.	Boilers	3	

FOURTH YEAR.

Course Numbers		Courses.	Periods per week	
			Class	Lab'y
		First Semester		
V.	5.	Economic Geology	3	
V.	3.	Mine Economics	2	
VI.	4.	Ore Dressing	3	6
VI.	7.	Design of Mine Plant		3
VII.	5.	Metallurgy of Gold and Silver	3	8
IV.	8.	Engines	3	
		Second Semester		
V.	5.	Economic Geology	3	
VIII.	10.	Air Compression and Pumping	3	
VII.	9.	Metallurgical Laboratory	1	8
VI.	4.	Ore Dressing	2	3
VI.	7.	Design of Mine Plant		6
VI.	5.	Mine Administration and Accounts	1	
VI.	6.	Examination of Mines	1	3
IV.	10.	Masonry and Concrete	2	

METALLURGICAL ENGINEERING.

The aim of this four years course is to train the student for a professional career in any branch of metallurgical work. Attention is given during the first two years to such fundamental subjects as mathematics, chemistry, physics, geology, mineralogy and preliminary courses in engineering. Instruction in metallurgy proper begins in the third year, both lectures and laboratory experiments being employed for the purpose. Chemistry and geology are provided for, also. The work of the fourth year is along the line of advanced courses in metallurgy; especial attention being given to laboratory experiments, high temperature conditions of metallurgy, training in execution, and interpretation of results. Such higher branches of engineering, chemistry, and courses of importance in mining engineering claim a considerable share of attention.

The course has been chosen with special reference to giving to the student in metalurgical engineering a general knowedge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers		Courses.	Periods per week	
			Class	Lab'y
		First Semester		
II.	4.	Mechanics	3	
III.	5.	Ore Analysis	1	9
IV.	12.	Hydraulics	3	
V.	7.	Petrology	2	3
VI.	1.	Mining A.	3	
VII.	2.	Principles of Metallurgy	3	
II.	7.	Thermo-dynamics	3	
		Second Semester		
II.	4.	Mechanics	4	
V.	7.	Petrology	2	3
III.	6.	Fuel Analysis		3
VII.	1.	Fire Assaying	1	8
VII.	6.	Metallurgy of Iron and Steel	2	
VIII.	4.	Machine Design	2	6
VIII.	8.	Boilers	3	

FOURTH YEAR.

Course Numbers		Courses.	Periods per week Class	Lab'y
		First Semester		
VI.	4.	Ore Dressing	3	6
VII.	5.	Metallurgy of Gold and Silver	3	3
VII.	4.	Metallurgy of Copper and Lead	2	3
VII.	8.	Metallurgical Plant and Design	1	6
VII.	7.	Metallurgical Calculations	1	
IV.	8.	Engines	3	
		Second Semester		
VI.	4.	Ore Dressing	2	3
VI.	5.	Mine Administration and Accounts	1	
VII.	3.	Metallurgy of Zinc, etc.	3	3
VII.	11.	Furnaces	3	
VII.	8.	Metallurgical Plant and Design		6
VII.	9.	Metallurgical Laboratory	1	8
VII.	10.	Metallurgy of Gold and Silver	1	3

GEOLOGICAL ENGINEERING.

This course extending over a period of four years is intended primarily to train men to examine, report and direct the future development of mines. In the first two years the course prescribed is similar to that of the Mining Engineering Department, so that students have a thorough training in fundamental subjects, especially in mathematics, chemistry, surveying, and other preliminary courses in engineering. In the second and third years the attention of the student is directed largely to geological subjects related closely to mining, namely, topographical surveying, geological surveying, petrology, and economic geology, while still continuing his studies in chemistry, mining, metallurgy, etc. The fourth year is devoted largely to advanced work in mining geology, visiting and reporting in detail on geological problems connected with ore deposition in various mining fields. Attenton also is paid to the geological occurrence of petroleum.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers		Courses.	Periods per week Class	Lab'y
		First Semester		
II.	4.	Mechanics	3	
III.	5.	Ore Analysis	1	9
IV.	12.	Hydraulics	3	
V.	7.	Petrology	2	6
VI.	1.	Mining A.	3	3
VII.	2.	General Metallurgy	3	2
III.	10.	Physical Chemistry	2	
		Second Semester		
II.	4.	Mechanics	4	
V.	7.	Petrology	2	6
VI.	2.	Mining B.	3	
VII.	7.	Metallurgy of Iron and Steel	3	
VII.	1.	Assaying	1	8
V.	4.	Field Geology	1	8

FOURTH YEAR.

Course Numbers		Courses.	Periods per week Class	Lab'y
		First Semester		
V.	5.	Economic Geology	3	3
V.	9.	Ore Genesis		6
VI.	3.	Mine Economics	2	
VI.	4.	Ore Dressing	3	6
VI.	7.	Design of Mine Plant		3
VII.	4.	Metallurgy of Copper and Lead	2	3
VII.	6.	Metallurgy of Gold and Silver	3	3
		Second Semester		
V.	6.	Economic Geology	3	3
V.	8.	Geological Examination and Surveys	2	
V.	10.	Paleontology	2	6
VII.	4.	Metallurgy of Lead and Zinc	3	3
V.	11.	Special Problems		5
VIII.	10.	Air Compression and Pumping	3	
VI.	5.	Mine Administration and Accounts	1	
VI.	6.	Examination of Mines	1	3
VI.	7.	Design of Mine Plant		6

CIVIL ENGINEERING.

This department provides a course of study in the theory and application of the principles of civil engineering. The first two years of work are the same as in the other engineering courses, including practical work in drafting room and field, as well as instruction in the fundamental principles of mathematics and physics. In the third year the studies relate more directly to civil engineering. Technical courses cover the principles of structural and machine design, power and power transmission, and other fundamental engineering processes. In the drafting room the student applies those principles to the design of machines, and bridge and roof trusses. Sufficient field work is given to make the student thoroughly familiar with surveying instruments, and their use in road, mine, and railroad surveys. The proper care and adjustment of surveying and engineering instruments are made prominent in the training of the civil engineer.

FIRST AND SECOND YEARS.

See Pages 17 and 18.

THIRD YEAR.

Course Numbers		Courses.	Periods per week	
			Class	Lab'y
		First Semester		
II.	4.	Mechanics	3	
VIII.	7.	Heating and Ventilation	3	
IV.	4.	Roads and Pavements	3	
V.	7.	Petrology	2	3
IV.	12.	Hydraulics	3	
VIII.	6.	Strength and Materials	3	
II.	7.	Thermodynamics	3	
		Second Semester		
II.	4.	Mechanics	4	
IV.	11.	Municipal Engineering	3	
IV.	5.	Graphic Statics	3	3
V.	7.	Petrology	2	3
VIII.	4.	Machine Design	2	6
VIII.	8.	Boilers	3	
VII.	6.	Metallurgy of Iron and Steel	2	

FOURTH YEAR.

Course Numbers	Courses.	Periods per week Class	Lab'y
	First Semester		
IV. 7.	Stresses	3	
IV. 8.	Structural Details		6
IV.	Elective	3	
VIII. 8.	Engines	3	
IV. 10.	Masonry and Concrete	2	
	Second Semester		
IV. 9.	Water Supply Engineering	2	
IV. 6.	Irrigation and Drainage	3	
IV. 7.	Stresses	3	
IV. 8.	Structural Details		3
VIII. 9.	Contracts and Specifications	2	
VIII. 10.	Air Compression and Pumping	3	

CLASS SCHEDULE—FIRST SEMESTER.

PERIOD	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8:00 to 8:50	Trigonometry Calculus Prin. of Met.	Trigonometry Calculus	Trigonometry Calculus Prin. of Met.	Trigonometry Calculus	Trigonometry Calculus Prin. of Met.	Thermo-Dyn. Surveying, Shop, and Drawing Ore Dress. Lab.
8:50 to 9:40	Anal. Geom. Mine Surv. Econom. Geol.	Ex. Mech. Phys. Chem. Mine Econ.	Anal. Geom. Qual. Anal. Econom. Geol.	Ex. Mech. Phys. Chem. Mine Ecom.	Anal. Geom. Mine Survey Econom. Geol.	Surveying, Shop, and Drawing Ore Dress. Lab.
9:40 to 10:30	Gen. Geol. Mechanics Met. Gold and Silver Stresses	Gen. Geol. Thermodynam. Met. Lead and Copper Masonry & Conc.	Gen. Geol. Mechanics Met. Gold and Silver Stresses	Gen. Geol. Thermodynam. Met. Lead and Copper Masonry & Conc.	Quan. Anal. Mechanics Met. Gold and Silver Stresses	Surveying, Shop, and Drawing Ore Dress. Lab.
10:30 to 11:20	Algebra Mineralogy Ore Dressing Heat & Venti. Hydraulics	Algebra R. R. Survey. Str. Materials Met. Plant	Algebra Mineralogy Ore Dressing Heat & Venti. Hydraulics	Algebra R. R. Survey. Str. Materials Met. Calcula.	Algebra Mineralogy Ore Dressing Heat & Venti. Hydraulics	Surveying, Shop, and Drawing Ore Dress. Lab.
11:20 to 12:10	Gen. Chemistry Ex. Mechanics Mining A. Engines Roads and Pavements	Gen. Chemistry Petrology Alt. Currents	Gen. Chemistry Mining A. Engines Roads and Pavements	Gen. Chemistry Petrology Alt. Currents	Gen. Chemistry Mining A. Engines Roads and Pavements	Surveying, Shop, and Drawing Ore Dress. Lab.
P. M. 1:00 to 2:00	Spanish	Spanish	Spanish	Spanish	Spanish	Surveying, Shop, and Drawing Ore Dress. Lab.
2:00 to 5:00	Gen. Chem. Quan. Anal. Ore Anal. Eng. Lab. (2 to 3)	Mech. Draw. Physics Lab. Petrology	Gen. Chem. Quan. Anal. Ore Anal. Struct. Details	Mech. Draw. Mineralogy Mine Plant Design	Wood Shop Quan. Anal. Ore Anal. Struct. Details A. C. Lab.	Surveying, Shop, and Drawing Ore Dress. Lab.

CLASS SCHEDULE—SECOND SEMESTER.

PERIOD	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8:00 to 8:50	Calculus Irrig. & Drain.	Calculus Spher. Trig. Met. Lab. Lect.	Calculus Irrig. & Drain.	Calculus Spher. Trig.	Calculus Irrig. & Drain. Gold and Silver	Gen. Surveying Field Surv. Fire Assaying Met. Lab.
8:50 to 9:40	Econ. Geology Elect. & Mag. Desc. Geom. Mining B. Municipal Eng.	Heat and Light Ore Dressing Gen. Surveying	Econ. Geology Elect. & Mag. Desc. Geom. Mining B. Municipal Eng.	Heat and Light Ore Dressing Gen. Surveying	Econ. Geology Quan. Anal. Desc. Geom. Mining B. Municipal Eng.	Field Surv. Field Geology Fire Assaying Met. Lab.
9:40 to 10:30	Mineralogy Theor. Mech. Electro. Met. Stresses	Geology Theor. Mech. Iron & Steel Water Sup. Eng.	Mineralogy Theor. Mech. Electro. Met. Stresses	Geology Theor. Mech. Iron & Steel Water Sup. Eng.	Mineralogy Anal. Geom. Assaying Stresses	Field Surv. Field Geology Fire Assaying Met. Lab.
10:30 to 11:20	Algebra Boilers Mine Admin.	Anal. Geom. Petrology Met. of Zinc Top. Surveying	Algebra Boilers Exam. of Mines	Anal. Geom. Petrology Met. of Zinc Top. Surveying	Algebra Boilers	Field Surv. Field Geology Fire Assaying Met. Lab.
11:20 to 12:10	Heat & Light Gen. Chemistry Air Compress. Graphic Stat.	Machine Design Gen. Chemistry Contracts and Spec.	Air Comp. Gen. Chemistry Graphic Stat.	Machine Design Gen. Chemistry Contracts and Spec.	Elect. & Mag. Gen. Chemistry Air Compress. Graphic Stat.	Field Surv. Field Geology Fire Assaying Met. Lab.
P. M. 1:00 to 2:00	Spanish Furnaces	Spanish	Spanish Furnaces	Spanish	Spanish Furnaces	Field Surv. Field Geology Fire Assaying Met. Lab.
2:00 to 5:00	Qual. Anal. Heat & Light Machine Design Mine Plant Design	Shop Elect. & Mag. Met. Design	Qual. Anal. Quant. Anal. Petrology Water & Fuel Mine Plant Design	Shop Mach. Draw. Mineralogy Met. Design Struct. Details	Qual. Anal. Quant. Anal. Water & Fuel Mach. Draw. Gold & Silver Lab.	Field Surv. Field Geology Fire Assaying Met. Lab.

DEPARTMENTS OF INSTRUCTION

I. DEPARTMENT OF MATHEMATICS

Doctor MacKay.

The study of mathematics is emphasized as a necessary basis for the further instruction in the engineering subjects. The courses have been arranged to meet the extensive needs of students in the various branches of engineering and are intended to develop power of deduction as well as to familiarize the student with the various methods of calculation used in practical problems. Students are encouraged to use logarithms and the slide rule when the latter can be employed without too great loss of accuracy. They will also be introduced to various books of tables that facilitate calculation.

1. Advanced Algebra.

The work begins with a review of elementary algebra. This is followed by the solution of simple and quadratic equations with a large number of practical problems, the summation of arithmetical and geometrical progressions, graphical solutions of equations, vector quantities, variation and proportion, partial fractions, logarithms, inequalities, probabilities, abridged methods of calculation, slide rule, and limits of error.

Prerequisite: *Elementary Algebra.*

Time: Class-room, five periods a week, first semester; three periods a week, second semester.

Text: Hawkes, *Advanced Algebra.*

2. Trigonometry.

A thorough knowledge of the subject matter of this course is essential for the successful carrying out of general surveying, topographical surveying, and mine surveying. It deals with the measurement of angles; the relations among the sine, cosine, and tangent of an angle; the values of the functions of multiple and fractional angles; the solution of simple trigonometric equations; the solution of right and oblique triangles, involving logarithmic calculations with tables and very many practical problems; the simplest elements of spherical trigonometry. The last mentioned subject is necessary for an understanding of the methods

of determining latitude and longitude, and also is essential for geodetic surveying.

Prerequisites: Elementary Algebra and Plane and Solid Geometry.

Time: Class-room, five periods a week, first semester; two periods a week, second semester.

Text: Murray, *Plane and Spherical Trigonometry with Tables.*

3. Analytic Geometry.

This subject combines the methods used in algebra and in geometry, and employs them in the study of simple curves, surfaces, and solids. It therefore affords a good introduction to mechanical drawing, mapping, surveying, and mensuration. It deals with plotting with different systems of co-ordinates, estimation of areas, properties of systems of straight lines, circles, the parabola, the ellipse, the hyperbola, changes produced in maps by change of origin and rotation of axes, simple curves in three dimensions, surface areas and volumes of simple solids.

Prerequisites: Courses 1 and 2 of this department must accompany or precede this course.

Time: Class-room, three periods a week, first semester; two periods a week, second semester.

Text: Smith and Gale, *New Analytic Geometry.*

4. Differential Calculus.

This subject is of great importance in the study of curves, of rates of variation, of maximum and minimum values; and is indispensable for the reading of most text-books of science, especially as applied in text-books on engineering. It includes limits, curve tracing and other applications of the derivative, maxima and minima, radii of curvature, summation of series, partial differentiation, and the solution of many problems in least cost and maximum efficiency.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, five periods a week, first semester.

Text: Murray, *Differential and Integral Calculus.*

5. Integral Calculus.

The integral calculus is the most powerful weapon of calcu-

lation. It is applied in this course to the calculation of lengths of curves, areas of surfaces, volumes of solids, moments of inertia, centers of gravity, work performed by bodies moving against given forces, and in many other applications to mechanics, heat, electricity and magnetism, and mensuration.

Prerequisites: Courses 1, 2, 3, and 4 of this department.

Times: Class-room, five periods a week, second semester.

Text: Murray, *Differential and Integral Calculus.*

SPECIAL AND GRADUATE COURSES IN MATHEMATICS.

Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work. The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in mathematical investigation of problems of engineering or applied science. The idea that an engineer should be a practical rather than a theoretical mathematician has guided the selection of elective and graduate courses. Students who wish to take optional work should arrange at the beginning of the college year with the head of the department of mathematics.

In addition to the foregoing, which are required of all students of engineering, the following elective and graduate courses are offered:

6. Integrals of Mechanics.

Certain types of integrals which are met with great frequency in the study of mechanics, are treated. These integrals, namely, the inertia integrals, those defining mass, and moment and center of mass, are essential in the discussion of the motion and the conditions of equilibrium of systems of particles and rigid bodies. Other integrals are studied, involving applications of mechanics to work, attraction, pressure, and centers of gravity and pressure.

Text: Lester, *The Integrals of Mechanics.*

7. Applications of the Calculus to Mechanics.

Wherever the teaching of mathematics to engineering students is discussed, and frequently in cases of other classes of students, the criticism which is almost without exception the most insistent is this: that the student leaves the course without adequate

ability to apply his mathematical knowledge. This means that he has not the faculty of taking a problem, giving it an analytic formulation, and interpreting the analytic results. This course is intended to supply the needed training. Students should obtain a comprehensive view of this course, partly because of the value of such a course as a means of general mental development, partly because new practical applications of discoveries in engineering are continually being made, and because no one can predict what particular facts or principles are most likely to find important practical applications in the future.

Text: Hedrick & Kellogg, *Applications of the Calculus to Mechanics.*

8. Differential Equations.

In many colleges of engineering, the need is felt for a course treating the subject of Differential Equations, limited in scope, yet comprehensive enough to furnish the student of engineering with sufficient information to enable him to deal intelligently with any differential equation which he is likely to encounter. To meet this need is the object of this course. Numerous applications to problems in Geometry, Physical Sciences, and Engineering are introduced.

Text: Cohen, *An Elementary Treatise on Differential Equations.*

II. DEPARTMENT OF PHYSICS

Doctor MacKay.

The courses in physics outlined below serve to introduce students to accurate measurements identical with or similar to those which he will have to perform frequently as an engineer. In general, the experiments carried out in these courses help him to understand the physical bases for the varied methods of proceedure in engineering processes. The apparatus for the course in experimental mechanics is of a very substantial character. This apparatus is well adapted for illustrating principles that lie at the foundation of an engineer's work. As in the other courses in this department, the laboratory work is accompanied by lecture room discussions and by the working out of illustrative problems. The course in heat forms an introduction to metallurgical processes especially. The course in light is introductory to much of the succeeding work in mineralogy and petrography. The elementary course in electricity and magnetism is devised for students of all branches of engineering, especial attention being paid to electrolysis and to the methods of action of simple electrical machines. The student is here introduced to the measurement and calculation of the principal electrical quantities that are met with in common engineering practice. The succeeding courses in electricity and magnetism are intended to give an opportunity for a deeper study of these subjects, and are intended especially for students who wish to specialize in electrical engineering, or in electrical machinery for mine plants, etc.

1. Experimental Mechanics.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments. (1) Uniformly accelerated motion; (2) Relation of force to mass and

to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficiency of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Measurement of gravitation constant; (13) Centripetal force; and a few other exercises if time permits.

Prerequisites: Course 2 of Department 1.

Time: Class-room, three periods a week, first semester.
Laboratory, three periods a week, first semester.

Text: Millikan, *Mechanics, Molecular Physics and Heat.*
Duff, *A Text Book of Physics.*

2. Heat and Light.

The first part of this course will deal with temperature, expansion, thermal conductivity, radiation, convection, change of state, calorimetry, with simple applications to furnaces, ventilation, and heat engines. The second part of the course will deal with the laws of reflection and refraction of light, combinations of lenses, eye-pieces and objectives of microscopes, prisms, double refraction, the spectrometer, polarized light and photometry.

Prerequisites: Course 1 of this department.

Time: Class-room, three periods a week, second semester.
Laboratory, three periods a week, second semester.

Text: Duff, *A Text Book of Physics.*
Millikan and Mills, *Electricity, Sound and Light.*
Millikan, *Molecular Physics and Heat.*

3. Electricity and Magnetism.

This course deals with the elementary principles of electricity, magnetism, and the practical application of the same to dynamos, motors, lamps and electric furnaces. Qualitative experiments are performed in the lecture-room to illustrate the principal phenomena of this very large and fruitful subject. Quantitative experiments are performed in the laboratory in order to make the electrical and magnetic quantities as much as possible real quantities in the experiment of the student.

Prerequisite: Course 1 of this department must precede or accompany.

Time: Class-room, three periods a week, second semester.
Laboratory, three periods a week, second semester.

Text: Duff, *A Text Book of Physics.*
Silvanus Thompson, *Elementary Lessons in Electricity and Magnetism.*
Millikan and Mills, *Electricity, Sound and Light.*

4. Mechanics.

The principal topics taken up are force, combinations of forces, center of gravity, moment of inertia, gravitation, stress, numerous cases of equilibrium, cords, jointed frames, friction, velocity and acceleration, harmonic motion, translation, rotation, work, energy, impulse, momentum, and very many simple practical problems with different forms of structures and machines.

Prerequisites: Courses 2, 3, 4, and 5 of Department I and Course 1 of this department.

Time: Class-room, three periods a week, first semester; and four periods a week, second semester.

Text: Maurer, *Technical Mechanics.*
Sanborn, *Mechanics Problems.*

5. Electromagnetism.

A discussion of the fundamental equations of electricity and magnetism; and calculation of field intensities, resistances, capacities, self and mutual induction, etc.

Prerequisites: Courses 4 and 5 of Department I and Course 3 of this department.

Time: Class-room, three periods a week, second semester.

Text: Poynting and Thomson, *Electricity and Magnetism.*

6. Alternating Current Measurements.

Measurements of magnetic permeability of various kinds of iron and steel, induction of coils, capacities, efficiency of dynamos and motors, efficiency of transformers, etc. The principal types of alternating dynamos and motors will be studied, as well as the applications of alternating currents to electric lighting and to power transmission.

Prerequisites: Courses 1 and 3 of this department.

Time: Class-room, two periods a week, first semester.
Laboratory, three periods a week, first semester.

Text: Pender, *Elements of Electrical Engineering.*

7. Thermodynamics.

The application of the laws of heat and mechanics to the steam engine, internal combustion engines, refrigerators, compression and pumping machinery.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, three periods a week, first semester.

Text: Cardullo's *Practical Thermodynamics.*

III. DEPARTMENT OF CHEMISTRY

PROFESSOR ILLINSKI.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of student.

1. Elements of Chemistry.

This course is introductory to the engineering courses and is required of all students. It comprises three lectures and two laboratory periods per week. The fundamental principles of the science are taught in connection with the descriptive chemistry of the various elements. The lectures are designed to precede the work of the laboratory, in which the student is expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking are required of each student.

No previous study of chemistry is required for admission to this course, but the instruction is so arranged that students who have already spent considerable time upon chemical work in secondary schools are admitted to lectures and laboratory work of a somewhat advanced character, in which the knowledge which they have already acquired is utilized.

Time: Class-room, five periods a week, first and second semester.
Laboratory, six periods a week, first and second semester.

Text: Smith, *General Chemistry for Colleges.*
Smith, *A Laboratory Outline of General Chemistry.*

2. Qualitative Analysis.

This course includes class-room instructions (one period per week), laboratory practice, and individual conference with instructors in the laboratory. The student is required to analyze

alloys, minerals, rocks, pigments, slags, mattes, and industrial products of various sorts and complexity. An effort is made to avoid mere thoughtless mechanical laboratory work on the part of the student and to give him an insight into the chemical principles involved in the processes studied.

This course is required of all students.

Prerequisite: Course 1 of this department.

Time: Class-room, one period a week, first semester.
Laboratory, nine periods a week, second semester.

Text: Treadwell & Hall, *Analytical Chemistry,* Vol. I.
Baskerville & Curtman, *Qualitative Analysis.*

3. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

The gravimetric determination of chlorine in a soluble chloride; water of crystallization in copper sulphate; iron and sulphur in ferrous or ferric sulphate; carbon dioxide; calcium, and magnesium in dolomite; silver and copper in a dime; tin, lead, copper, and zinc in a bronze; and silica in an insoluble silicate.

The class-room work consists of lectures and quizzes in which the various analytical processes are studied from the standpoint of modern chemical theories. Required of all students.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one period a week, first and second semesters.
Laboratory, nine periods a week, first and second semesters.

Texts: Treadwell & Hall, *Analytical Chemistry.* Vol. II.
Olsen, *Quantitative Chemical Analysis.*

4. Ore Analysis.

A thoroughly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various

methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products.

Each student is required to analyze two ore more ores for each of the following: Iron, copper, zinc, lead, phosphorus, calcium, manganese, silica, sulphur, and arsenic. After this he will be required to accurately complete from ten to thirty determinations for any of the foregoing ores in one half day, thereby gaining a little of the speed and accuracy necessary to every practical assayer.

Prerequisite: Course 3 of this department.

Time: Class-room, one period a week, first semester.
Laboratory, nine periods a week, first semester.

Text: Low, *Technical Methods of Ore Analysis.*

5. Water and Fuel Analysis.

Analyses of water are made in regard to their possible use in boilers. These analyses involve determination of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 3 of this department.

Time: Laboratory, second semester.

Texts: Stillman, *Engineering Chemistry.*
Treadwell & Hall, *Analytical Chemistry,* Vol. II.

Analysis of various coals and other fuels are made, their heat values calculated from these analyses and also determined by means of a calorimeter. Flue gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.

Time: Laboratory, three periods a week second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

6. Advanced Quantitative Analysis (Special).

This course is the extension of Course 3 or 4, and the work will be chosen to suit the needs of each student. It may consist of the complete analysis of rocks and minerals, advanced ore analysis, iron and steel analysis, cement analysis, or the determination of some of the rare elements.

Prerequisite: Course 3 of this department.

Time: Laboratory, six periods a week, one semester.

7. Electro-Analysis (Special).

This course will deal with the practical application of the electric current in determining some of the common metals such as copper, silver, lead, and zinc. After the student has become familiar with the methods used for determining each of these, he will use the current in separating mixtures of metals and as a rapid, accurate method of ore analysis.

Prerequisite: Course 3 of this department.

Time: Laboratory, three periods a week, one semester.

Text: Edgar F. Smith, *Electro Analysis.*

8. Physical and Theoretical Chemistry.

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisite: Course 3 of this department.

Time: Class-room, two periods a week, first semester.

Text: Walker, *Introduction to Physical Chemistry.*

9. Inorganic Preparations (Special).

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 2 of this department.
Time: Class-room, one period a week, second semester.
Laboratory, six periods a week, one semester.

10. Industrial Inorganic Chemistry (Special).

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two periods a week, one semester.
Text: Rogers & Aubert, *Industrial Chemistry.*

11. Organic Chemistry (Special).

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two periods a week, one year.
Laboratory, six periods a week, one year.
Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

IV. DEPARTMENT OF CIVIL ENGINEERING

PROFESSOR KINGMAN.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the work of the fourth year the student is given instruction in Structural, Sanitary, and Hydraulic Engineering. The work, which is largely drawing and design, covers practical problems, with the intent that the student may become thoroughly familiar with the principles governing his profession and with their application.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies.

1. General Surveying.

The introductory course in surveying deals with the principles of land measurement, and with the instruments used in both field and office.

In the class-room, the adjustments of the level and transit are taught, and the uses of these instruments in land surveying illustrated by practical problems.

In the field practice, each student becomes familiar with the use of the chain, tape, level, transit, etc.

Prerequisite: Course 2 of Department I.

Time: Class-room, three periods a week, second semester.
Field, four periods a week, second semester.

Text: Breed & Hosmer, *Theory and Practice of Surveying.*

2. Railroad and Mine Surveying.

The work consists of field, recitations and drafting room practice.

The course is devoted to the mathematics of railroad curves together with the methods of staking out curves and computing earthwork.

Prerequisite: Course 1 of this department.

Time: Class-room, two periods a week, first semester.
Field work, four periods a week, first semester.

Text: Allen, *Railway Curves.*

3. Topographical Surveying

The theory and use of the stadia and other instruments used in making a topographic survey are considered, as are also the methods of topographic surveying. Some time is given to topographic drawing. A complete topographic survey based on a system of triangulation is executed, including the calculations, and platting and completing the map. Especial attention is given to the precise measurement of bases and angles.

Prerequisite: Course 1 of this department.

Time: Class-room, two periods a week, second semester.
Field, four periods a week, second semester.

Text: Breed & Hosmer, *Higher Surveying.*

4. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways; location, construction, drainage, improvement and maintenance of country roads; various paving materials—broken stone, brick, asphalt, wood and stone blocks, and concrete; foundations for and adaptability of each; arrangement and details of city streets.

Prerequisite: Course 1 of this department.

Time: Class-room, three periods a week, first semester.

Text: Baker, *Roads and Pavements.*

5. Graphic Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 4 of Department II.

Time: Class-room, three periods a week, second semester.

Text: Sondericker, *Graphic Statics.*

6. Irrigation and Drainage.

A series of lectures treating of the design and construction of canals, flumes and other special means for supplying water to the soil. This is followed by a course in drainage designed to familiarize the student with the best methods of surveying and construction of drainage systems for large areas.

Prerequisite: Course 1 of this department.

Time: Three periods a week, second semester.

Text: To be determined at beginning of term.

7. Stresses.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow, and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind, and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisite: Course 6 of Department VIII.

Time: Class-room, three periods a week, one year.

Text: Merriman & Jacoby, *Roofs and Bridges,* Parts I and IV.

8. Structural Details.

Practical applications of the principles of stresses in the design and proportion of the various parts of engineering struc-

tures. Each student makes a detailed design of a steel roof truss with its supporting columns, a plate girder bridge for railroad traffic, and a highway Pratt truss span.

Prerequisites: Course 6 of Department VIII and Course 5 of this department must accompany.

Time: Laboratory, two periods first semester, and one period second semester.

Text: Merriman & Jacoby, *Roofs and Bridges*, Part III..

9. Water Supply Engineering.

The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, method of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 12 of this department.

Time: Class-room, two periods, second semester.

10. Masonry and Concrete.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cement, wood, iron and steel. Special emphasis is placed upon the geological occurrence of suitable engineering materials and their methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood pipe, and stone arches.

This course also deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties and methods of testing the materials used,

various types of reinforcement, forms, facing and finishing.

Prerequisite: Course 9 of this department.

Time: Class-room, three periods a week, second semester.

Texts: Baker, *Masonry Construction* and *Hool on Concrete.*

11. Municipal and Sanitary Engineering.

A study of the quantity of house-sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 12 of this department.

Time: Class-room, three periods a week, second semester.

Text: Folwell, *Sewerage.*

12. Hydraulics.

Under this head are treated fluid pressure, the principles of fluid equilibrium, and the laws governing the flow of water through orifices, over weirs, in closed conduits, and in open channels. The hydraulic laws relating to turbines and centrifugal pumps are briefly discussed, showing to what extent theory applies to these subjects.

Prerequisites: Course 4 of Department II and Course 6 of Department IV.

Time: Class-room, three periods a week, first semester.

Text: Merriman, *A Treatise on Hydraulics.*

V. DEPARTMENT OF GEOLOGICAL ENGINEERING

PROFESSOR ANDERSON.

This department aims to give its students knowledge concerning bodies of ores and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditions, so that mining may become more and more a business and that the element of chance may be reduced to a minimum.

1. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals, rapid sight determination of unlabeled specimens being especially emphasized.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such min-

eral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts, salts of the organic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 2 of Department III.

Time: Class-room, three periods a week, one year.

Texts: Rogers, *Study of Minerals.*
Brush and Penfield, *Determinative Mineralogy and Blowpipe Analysis.*

2. General Geology.

All the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow in part, at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory work in the rock collections, and in study and interpretation of topographic maps, and frequent excursions into the field. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail, training in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena

are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Limitar mountain, ten miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited, and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Prerequisite: Course 1 of this department.

Time: Class-room, four periods a week, first semester.

Texts: Chamberlain and Salisbury, *College Geology*.
Scott, *Introduction to Geology*.

3. General Geology.

Discussion of theories of earth genesis, the principles of stratigraphy, and the geologic history of the development of the North American continent, involving laboratory work with type fossils and rock collections.

Prerequisite: Course 2 of this department.

Time: Class-room, three periods a week, second semester.

Text: Chamberlain and Salisbury, *College Geology*.

4. Field Geology.

Each student is assigned a limited area within the Socorro Quadrangle. Instruction is given in the field in observing and recording geological phenomena and the preparation of maps and sections. The collections made are then studied in the laboratory and a complete report describing the geology of the area is required.

Prerequisites: Course 3 of Department IV and Courses 1, 2, and 3 of this department.

Time: Saturdays, first semester.

5. Economic Geology.

This course embraces the study of the theories of ore deposition and the general features and formation of ore bodies and classification of ore deposits. This is followed by a description of the deposits of the ores of iron, copper, lead, zinc, silver, gold, and the lesser metals, with special reference to North America.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three periods a week, first semester.

Text: Lindgren, *Mineral Deposits and Lecture Notes.*

6. Economic Geology.

This course embraces the study of the non-metallic minerals of economic importance. A description of the distribution and occurrences of coal, petroleum, natural gas, asphalts, building stones, water supply, clays, cement rock, salt, gypsum, sulphur, fertilizers, abrasives, gems, and minor minerals.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, three periods a week, second semester.

Collateral readings and reports on assigned topics are required of students in Mining Geology.

Time: Laboratory, three periods a week, one year.

7. Petrology.

A discussion of the origin, mineralogical and chemical composition, field classification, and nomenclature, and microscopic structure of the crystalline, sedimentary, and metamorphic rocks. This is supplemented by field and laboratory work in the rock collections.

Prerequisites: Courses 1, 2, and 3 of this department.

Time: Class-room, two periods a week, one year.
Laboratory, three periods a week, one year.

Texts: Kemp, *Handbook of Rocks and Lecture Notes.*
Luquer, *Minerals in Rock Sections and Lecture Notes.*

8. Geological Examinations and Surveys.

A discussion of the methods of systematically recording and interpreting geological phenomena, and the organization and scope of geological surveys. This is followed by a sketch of the history and results of state and national geological surveys in the United States, and of other sources of detailed information regarding local geology.

Prerequisites: Courses 1, 2, 3, 5, and 6 of this department.

Time: Class-room, two periods a week, second semester.
Lecture Notes.

9. Ore Genesis.

The study of the paragenesis and origin of the minerals of a certain ore deposit. The student makes a collection of the deposit which is then studied in the laboratory by means of microscopic slides and polished surfaces and microchemical tests, etc.

Prerequisites: Courses 1, 2, 3, 4, 5, and 6 of this department.

Time: Laboratory, six periods a week, first semester.

10. Paleontology.

A study of the invertebrate index fossils characteristic of the geologic horizons of North America.

Prerequisite: Course 3 of this department.

Time: Class-room, two periods a week, second semester.
Laboratory, six periods a week, second semester.

Text: Grabau and Shimer, *North American Index Fossils.*

11. Special Problems.

Research work in some branch of the science of geology, such as investigation in petrology, stratigraphy, paleontology, or ore deposits. This work may form the basis of a thesis in Geological Engineering.

Prerequisites: Courses 3, 5, 6, and 7 of this department.

Time: Laboratory, five periods a week, second semester.

VI. DEPARTMENT OF MINING ENGINEERING

PROFESSOR FAHRENWALD.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. The entire course is pre-eminently practical in character.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Prospecting by panning, trenches, test pits, boring and drilling. Testing of placers and ore deposits with well or chain drills.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts; quarrying.

Machine drills: Construction and operation.

Tunneling: Methods of driving and timbering; permanent linings; sizes; speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubing.

Methods of support: Pillars, timbers, filling.

Excursions are made to neighboring mines on Saturdays.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 1 of Department III.

Time: Class-room, three periods a week, first semester.

Texts: Foster, *Elements of Mining and Quarrying.*
Lecture Notes.

2. Mining, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Ore extraction by systems of overhand and underhand stoping; caving by top slicing and sub-drifting; support of workings by filling and square-setting.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives.

Hoisting: Engines, drums, wire rope, skips and cages; head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Arrangements at top and underground landings: Ore pockets; signalling, etc.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiency of fans.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, three periods a week, second semester.

Texts: Same as in Course 1.

3. Mine Economics.

Among the subjects studied are: Factors governing the value of a mine; relation of labor; selling price of products, and profit; comparative efficiency of mining methods, plants, etc.; profit; comparative efficiency of mining mtehods, plants, etc.; balancing the cost of mining equipments against the saving effected to see whether or not the installation is advisable.

Prerequisite: Course 2 of this department.

Time: Class-room, two periods a week, first semester.

Text: Hoover, *Principles of Mining.*
Lecture Notes.

4. Ore Dressing.

This course includes a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil flotation.

Prerequisites: Course 3 of Department I; Courses 1 and 2 of Department II; Course 12 of Department VIII must precede or accompany.

Time: Class-room, three periods a week, first semester; two periods a week, second semester.

Text: Richards, *Ore dressing and Concentration.*

5. Mine Administration and Accounts.

Particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of supplies, mine accounts, statement of cost, and monthly reports are discussed.

Time: Class-room, one period a week, second semester.

6. Examination of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside construction, the character of the geological formations,

the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant.

Time: Class-room, one period a week, second semester.
Field, three periods a week, second semester.

7. Design of Mine Plant.

The student is assigned problems relating to a given mine. He makes the requisite surveys, plans the top-works, selects the requisite machinery for a specified duty, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or of the Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings.

Time: Laboratory, three periods a week, first semester; six periods a week, second semester.

8. Mine Surveying and Mapping.

The work consists of field practice, recitation and drafting room exercises.

In the field surveys of mining claims and underground workings are made. The mapping is done in the drafting room from the notes thus taken.

Prerequisites: Course 1 of Department IV.

Time: Class-room, 2 periods, first semester.
Field work: four periods, first semester.

Text: To be determined later.

VII. DEPARTMENT OF METALLURGICAL ENGINEERING

PROFESSOR FAHRENWALD.

The aim of the Metallurgical Department is to give its graduates a thorough working knowledge of assaying, chemistry, millwork and smelting processes; and to equip them with the knowledge necessary to the successful management of metallurgical plants, or to take charge of metallurgical operations.

This special training is given by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead. The crucible-assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assayers are conidered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Course 3 of Department III, and Course 1 of Department V.

Time: Class-room, one period a week, second semester.
Laboratory, eight periods a week, second semester.

Text: Lodge, *Notes on Assaying.*

2. Principles of Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

Particular stress is laid upon the study of the more recent metallurgical practices and improvements of older processes. The course is supplemented by visits to neighboring plants.

Prerequisites: Course 1 of Department II; Course 1 of Department III; and Course 1 of Department V must precede or accompany.

Time: Class-room, three periods a week, first semester.

Text: Fulton, *Principles of Metallurgy.*

3. Metallurgy of Zinc and Minor Metals.

This subject takes up the roasting of zinc ores; zinc distillation process; furnaces; purification of spelter; and commercial consideration of such metals. The metallurgy of Antimony, Nickel, Tin, Bismuth, Tungsten and Arsenic.

Time: Class-room, two periods a week, second semester.
Lectures and Notes.

4. Metallurgy of Copper and Lead.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bassemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant; occurrence of lead ores; methods of roasting and roasting furnaces; Corinthian, Silisian and English methods of reverberatory smelting; blast furnace smelting; calculation of blast furnace charges; and desilverization of base bullion.

Prerequisites: Course 2 of this department.

Time: Class-room, two periods a week, first semester.

Texts: Peters, *Principles of Copper Smelting.*
Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel process; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixivation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.
Time: Class-room, three periods a week, first semester.
Texts: McFarren, *Cyanide Practice.*
Del Mar, *Stamp Milling.*

6. Metallurgy of Iron and Steel.

Modern methods for the production of pig iron, wrought iron and steel; the iron blast-furnace; white cast-iron; gray cast-iron and spiegel-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.
Time: Class-room, two periods a week, second semester.
Text: Stoughton, *Metallurgy of Iron and Steel.*

7. Metallurgical Calculations.

A course based on Richard's Metallurgical Calculation. It is designed to bring the student in contact with the more important calculations in connection with the practice of thermo-chemistry and various smelting operations, also electro-metallurgy.

Time: Class-room, one period a week, first semester.

8. Metallurgical Plant and Design.

The student devotes his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two students have the same work. The working plans for part of the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bills of materials are made out for the portions of the work assigned, and the cost of the several parts carefully estimated according to the trade conditions and labor factors existing at the time. The

entire work and all computations are carried out according to the best engineering practice and with the same care that actual construction operations require.

Prerequisites: Course 6 of Department IV; Course 6 of Department V; Course 23 of Department IV; and Course 2 of this department.

Time: Laboratory, three periods a week, first semester, and six periods a week, second semester .

9. Metallurgical Laboratory.

Laboratory work and investigation will be conducted along some of the following lines: Amalgamation of ores of gold and silver, chlorination of gold and silver ores, cyanidation of gold and silver ores, leaching methods for copper ores, electrolytic refining for copper and lead, slags.

Prerequisites: Courses 4, 5, 6 and 7 of this department must precede or accompany this course.

Time: Class-room, one period a week, second semester.
Laboratory, eight periods a week, second semester.

10. Metallurgy of Gold and Silver.

An advanced course for metallurgical students.

Texts: Clennel, *The Cyanide Hand Book.*

References: Julian and Smart, *Cyaniding Gold and Silver Ores.*
McFarren, *Cyanide Practice.*

Time: One period a week, first semester.

11. Furnaces.

This course is given by way of an extension of the topic ''furnaces'' as treated in Principles of Metallurgy. It is concerned with the theories of high temperature generation, heat conservation, measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three periods a week, second semester.

Text: Damour, *Industrial Furnaces.*

Mining and Metallurgical Trips.

During the first semester of the junior year a number of trips are taken to the mines, mills, and smelters which are within easy reach of the School. The officials at the various plants have been uniformly courteous in allowing the School the opportunity to make these visits, and have placed at the disposal of the students everything essential to a clear understanding of the mode of operation.

These excursions give the student a chance to see in operation and practice what heretofore he may have known only theoretically and give him a command of the subject that cannot be obtained in the class room.

Among the properties visited and at the disposal of the School are:

The old Torrance and Merritt mines, three miles from the campus, in the Socorro Mountains. These mines were once rich producers but are now being re-exploited.

The Merritt Mine has an incline shaft equipped with gasoline hoist and self-dumping skip, and a considerable amount of drifting, raises, winzes, and stopes. Practically all the operations of mining may be seen at these two mines.

The coal mines at Carthage, New Mexico, are within easy reach of the School and present to the student difficulties, and their solution, in mining, haulage, ventilation, and water supply. The use of electricity in mining is prominently brought to the student's notice.

The zinc district at Kelly, New Mexico, brings out the fact that success in mining is not all luck. There are three large mines and two mills available for inspection, and the student sees in the mines that geology is a live subject and essential to successful mining. In the mills, he gets his first insight into ore dressing and learns that there is more than one way of doing the same thing.

The Southwestern Portland Cement Company's plant at El Paso is visited and studied from the mechanical point of view. Here are seen in action various types of crushers, grinders, elevators, conveyors, feeders, etc. The company's quarry is a fine example of open cut mining and the student sees the uses of churn drills in drilling holes for blasting large charges.

A new custom smelting plant is now in course of erection in the southern part of the city by the Socorro Smelting Company. This plant when completed and in operation will afford an excellent opportunity for students to observe actual smelting practice right at the doors of the School.

At the smelter in El Paso, the student sees the working and handling of a large custom plant. Practically everything in the line of copper, lead, and silver smelting is before him for inspection. The methods of sampling, the blast roasting of lead ores, the roasting of copper ores, the blast furnace treatment of lead-silver ores, the blast furnace treatment of copper ores, the reverberatory smelting of copper ores, basic converting, casting machines, power houses, and assay offices are all made the subject of close observation.

Once in two years, a trip, open only to students who have taken work in the Mining or Metallurgical departments, is taken through the Southwest. The probable itinerary of this trip is as follows: Santa Rita, Hurley, Morenci, Clifton, Globe, Miami, Tombstone, Bisbee, Cananea, and Douglas.

VIII. DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSOR HANSON.

The aim of the department is to give the student a thorough training in the fundamental principles underlying engineering practice, in shop work, drafting and designing, arranged to illustrate the principles taught in the class-room.

The School is situated near the mining camps which are equipped with the larger and heavier types of power and mining machinery which furnishes the student with excellent examples of modern power plant installation.

The following is a brief description of the courses offered:

1. Wood Shop.

The student is taught the use and care of wood-working tools. Exercises in simple joints are then assigned and wherever possible useful exercises will be given.

Time: Six periods a week.

2. Mechanical Drawing.

This course comprises the drawing of 15 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented.

The latter part of the semester is devoted to special practice in lettering and free hand sketching.

Prerequisites: Entrance requirements.

Time: Six periods a week, first semester.

3. Machine Drawing.

A continuation of Course 2. Here the student makes working drawings from machine parts already made; first while having the part directly before him, and later from a free-hand sketch of the part, without having the latter to look at while drawing. He thereby becomes familiar not only with methods of

dimensioning, laying out and reading working drawings but also those of making and using sketches. Through the entire course, particular stress is laid on neat lettering, correct dimensioning, and symmetrical arrangement of drawings.

The student is also taught tracing and blue printing.

Prerequisite: Course 2 of this department.

Time: Laboratory, six periods a week, second semester.

Text: Williams & Rautenstrauch.

4. Machine Design.

A study of the design of machine elements and modern machines, and of the nature, strength, and action under stress of the materials used in the machine construction. Recitations are carried on, including the discussion of problems suitable for illustration of important points. In the drafting room each student completes the design of some specially assigned simple machine.

Prerequisites: 2 and 3 of this department; Course 4 of Department I, must precede or accompany.

Time: Class-room, two periods a week, second semester.
Laboratory, six periods a week, second semester.

5. Descriptive Geometry.

The representation of all geometrical magnitudes are made possible by means of orthographic projection. The student is required to solve various problems involving points, lines, surfaces and solids and demonstrate same in exercises at the blackboard. A thorough knowledge of descriptive geometry is indispensable to the engineer.

Prerequisites: Course 2 of Department I, and Course 2 of this department.

Time: Class-room, three periods a week, second semester.

Text: Higbee, *Descriptive Geometry.*

6. Strength of Materials.

A study of the strength of materials, matematically treated, including the stresses and strains in bodies subjected to torsion, to compression, and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moment, slopes, and deflection; overhanging, fixed, and continuous beams, flat plates, and stresses in columns

and in beams subjected to tension and depression as well as bending; torsional stresses; and stresses in spring.

Prerequisite: Course 4 of Department I must accompany or precede.

Time: Class-room, two periods, first semester.

Text: Boyd, *Strength of Materials.*

7. Heating and Ventilating.

The theory and principles of the different systems of heating buildings by steam, hot air, hot water or combinations of these systems. Caluculations are made of the amounts of radiating surface required for each system and the auxiliary apparatus used with each. This is followed by a study of the different systems of ventilating.

Prerequisites:

Time: Class-room, three periods a week, first semester.

Text: Carpenter, *Heating and Ventilating.*

8. Steam Engines and Boilers.

In this course an elementary course in thermodynamics is given followed by the theory of the steam engine based on thermodynamics. This, in turn, is followed by a general descriptive course on engines and boilers, their types, details, construction and management. The whole course is supplemented by suitable problems to aid the student in his understanding and grasp of the subject.

Prerequisites: Course 2 of Department II.

Time: Class-room, three periods a week, first and second semester.

Texts: Peabody and Miller, *Steam Boilers and Engines.*
Ripper, *Steam Engines.*

9. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two periods a week, second semester.

Text: Johnson, *Engineering Contracts and Specifications.*

10. Air Compression and Pumping.

Part 1: Discussion of pumping, pump problems, and pump details. Types of Pumps: Force pumps, crank and fly wheel, direct acting, duplex, compound, and triple expansion pumps.

Part 2: A study of the action of air during compression and expansion, its flow through pipes, and also of the various types of air compressing and actuating machinery.

Prerequisites: Course 12 of Department IV.

Time: Class-room, three periods a week, second semester.

Texts: Barr, *Pumping Machinery.*
Peele, *Compressed Air Plant.*

ACADEMIC DEPARTMENT

PRINCIPAL GUNTER.

The minimum requirements for admission are one year of high school work consisting at least of one unit in English, one in algebra, and one optional. A two-year course is given corresponding closely to the tenth and eleventh grades of standard high schools.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, ioidmatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuabe technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

SECOND YEAR—FIRST SEMESTER.

Elementary Algebra.

A rapid review of factoring, linear equations, and square root and radicals is given during the first month. Quadratics including graphic representation, irrational equations, variations and the binominal theorem for positive and negative exponents are given special study.

Time: Five periods per week.

Texts: Hawkes, Luby and Touton.

English II.

Classics: Standard English and American classics are read and discussed in class, the memorizing of some of the most significant passages is required. An attempt is made to cultivate a taste for good literature. Supplementary reading from approved authors required.

Rhetoric: This deals with language as a medium through which ideas and thoughts are expressed; Description, Narration, Exposition and Argument.

Composition: Ability to write English.

Time: Five periods per week.

Texts: Brooks and Hubbard.

Plane Geometry.

Triangles, quadrilaterals, loci, arcs, chords, measure of angles and simple problems in construction are studied. They are developed by the inductive-deductive method, the inductive predominating.

Time: Five periods per week.

Texts: Wentworth and Smith.

SECOND YEAR—SECOND SEMESTER.

English II.

In this subject the work of the first semester is continued. *The Merchant of Venice* and *Hamlet* are read and discussed in class. As in the first semester, appropriate supplementary matter is read by each pupil.

Time: Five periods per week.

Texts: Brooks and Hubbard, *Composition and Rhetoric.*

Plane Geometry.

Work of first semester is continued. Books III, IV and V are studied. Deductive proofs predominate. The work is vitalized by solutions of simple exercises and practical problems requiring the use of the algebra of the previous year.

Time: Five periods per week.

Texts: Wentworth and Smith.

THIRD YEAR—FIRST SEMESTER.

English III.

I. History of American Literature.

II. Ability to Write Formal Themes.

III. Knowledge of American Literature: Washington's Farewell Address; Webster's Bunker Hill Oration; One Essay

from Emerson; Holme's Poems (selected); Hawthorne's Short Stories; Marble Faun, or House of Seven Gables; Longfellow's Poems (selected); Lowell's Poems (selected); Short Stories from Poe; One Novel from Cooper.

An intensive knowledge of four of the above and a general reading knowledge of the others is required.

Time: Five periods per week.

Texts: Selected.

Physiography.

This course furnshes preparation for the college work to follow. It is largely geological. Erosion, the work of ground water, rivers and valleys, the sea and its shores, and movements of the earth's crust are studied. Laboratory work in which maps, rock formations, etc., are examined and studied is given in connection with the special topics.

Time: Five periods per week.

Physics.

This course runs throughout the entire year the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. During this semester the subjects of mechanics, heat and work are studied.

Time: Four periods a week in class, with three periods laboratory.

Text: Millikan and Gale's *First Course in Physics,* with laboratory manual.

THIRD YEAR—SECOND SEMESTER.

English III.

I. History of English Literature.

II. Ability to Write Formal Themes.

III. Knowledge of English Literature: Burk's Speech of Conciliation; Macauley's Life of Johnson; Shakespeare's Macbeth, Hamlet, or King Lear.

Time: Five periods per week.

Text: Long, *English Literature.*

Physics.

This is a continuation of the first semester's work. Sound, light and electricity are treated in much the same manner as the subjects of the first half of the year. Throughout the course individual laboratory work is required. Each student must present a satisfactory note book of at least forty experiments performed by him during the year before credit will be allowed by instructor.

Time: Class-room,three periods per week.
Laboratory, six periods per week.

Texts: Millikan and Gale, *Laboratory Manual.*

Solid Geometry.

The work for the second semester includes the usual theorems and constructions of good text books covering the relations of lines and planes in space; the properties and measurements of prisms, pyramids, cylinders, and cones; the sphere; and the spherical triangle.

Time Five periods a week.

Text: Wentworth and Smith, *Solid Geometry.*

Drawing.

Instruction in elementary drawing is given during the entire course in the academy. This course is given to meet the requirement of the College for entrance into freshman drawing, the student completing this course will be amply prepared for the more advanced work of the College.

Industrial Training.

Elementary shop practice is given academic students who are not otherwise overburdened with work. The scope and arrangement of shop work will be made by the instructor in charge. Students who do not intend to take a full college course will do well to take advantage of work in the shop.

FOREIGN LANGUAGES.

No foreign language is taught except Spanish, a speaking knowledge of which has recently become a great advantage, if not a necessity, to a large percentage of the young men who

engage in any of the line of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge, for in Socorro and vicinity Spanish is as generally spoken as English.

1. Spanish.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercise each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language with the idea of learning the grammar from the language rather than the langauge from the grammar.

Time: Five periods a week, one year.

Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish.

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar* being used as a text. Five periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.

Time: Five periods a week, one year.

Instruction in Spanish is given by a Spanish-American who holds a scholarship in the institution. Such instructor is named at the beginning of the school year by the president. Two units are required in either Latin, Greek, French, German or Spanish for graduation from the college.

ACADEMIC CLASS SCHEDULE—FIRST SEMESTER

PERIOD	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8:00	Algebra II	Algebra II	Algebra II	Algebra II	Algebra II	
8:50	English III	English III	English III	English III	English III	
9:40	Physiography	Physiography	Physiography	Physiography	Physiography	
10:30	P. Geometry	P. Geometry	P. Geometry	P. Geometry	P. Geometry	
11:20	English II	English II	English II	English II	English II	
P. M. 1:00	Spanish	Spanish	Spanish	Spanish	Spanish	Drawing and Shop
2:00	Physics	Physics	Physics	Phys. Lab. (2 to 5)	Physics	

ACADEMIC CLASS SCHEDULE—SECOND SEMESTER

PERIOD	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A. M. 8:00	S. Geometry	S. Geometry	S. Geometry	S. Geometry	S. Geometry	
8:50	English III	English III	English III	English III	English III	
9:40	Algebra II	P. Geometry	Algebra II	P. Geometry	Algebra II	
10:30	P. Geometry	Algebra II	P. Geometry	Algebra II	P. Geometry	
11:20	English II	English II	English II	English II	English II	
P. M. 1:00	Spanish	Spanish	Spanish	Spanish	Spanish	Drawing and Shop
2:00	Physics	Physics	Physics	Phys. Lab. (2 to 5)	Physics	

BUILDINGS AND GROUNDS

BUILDINGS AND GROUNDS

The Campus.

The State School of Mines campus contains 32 acres of nearly level ground on the outskirts of the city of Socorro. Groves of trees have been planted and trees line the walks and drives.

Main Building.

The main building consists of three stories and a good basement. It is T-shaped, 135 feet long by 100 feet deep, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite in broken ashler and is trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated, heated with a good hot-water system, piped for water and gas, and wired for electricity for illumination and for experimental purposes.

As now arranged the main floor of this building contains the president's office, the mineralogical museum, the qualitative chemical laboratory and instructor's office, the assay laboratory and balance rooms, and a lecture room. The basement contains two lecture rooms, the physical laboratory, and instructor's private mineralogical laboratory, the quantitative chemical laboratory, the electro-chemical laboratory, an instructor's private chemical laboratory, the chemical supply rooms, a photographic dark room, the boiler room, the engine room, the hot water heating plant, and the lavatories. A lecture room, now occupied by the department of mathematics, is located on the second floor. The main library occupies the third floor.

Engineering Building.

The new engineering building is built in the shape of a Greek cross, 60 feet wide by 120 feet long, and 24 feet in height. It is of steel and concrete, with concrete roof, steel sash and heavy 3-ply tin doors; making the building entirely fire proof. There are 11 steel monitor type trusses in this building, six of 30-foot spans each, and five of 40-foot spans each. The trusses being

carried on steel columns, and the panels between the columns filled in with steel studdings and girts on which are fastened heavy metal laths. The building is plastered inside and out with cement. The monitor is about 10 feet wide and has a 3-foot top hung steel sash along both sides along the wings. The overhead sash serve also as ventilators, being operated below by an endless chain passing over a pulley, which in turn operates a worm gear. Heavy re-inforced window lights are used throughout the building. This system of lighting diffuses the light so that all parts of the building are equally well lighted. This building, with the exception of the south wing, has been completed during the present year.

Power Plant.

The new power plant building just completed is constructed of re-inforced concrete. The building is 34 feet long, 24 feet wide and 18 feet high. It is well lighted by 14 windows, each 4x6 feet, having heavy re-inforced glass. The structure is absolutely fire proof. The building is one of the most attractive structures on the grounds.

Ore Dressing and Treating Plant.

The building housing the machinery of this plant is a temporary building and is 50x40 feet in size, two stories high. This building is sufficiently large and well lighted for carrying on the work of the School at the present time. It is intended within a few years to erect a permanent and larger building for carrying on the metallurgical operations.

Dormitory.

The State School of mines suffered long for lack of dormitory accommodations. In fact, it is known that many students who would otherwise have come to the State School of Mines in years past went to other institutions because of the lack of the lower cost of living which a dormitory here would have afforded. However, the $15,000 generously appropriated by the territorial legislature was expended with the result that the School of Mines is equipped with what is probably the best dormitory in New Mexico. The building is heated with hot water and lighted with electricity. There are a dining room and kitchen in connection, also a bath room on each of the two floors and a shower

bath in the basement. The assembly room, on the first floor, which is now equipped for the accommodation of the academic department, promises to meet all the requirements of that department for some time to come. The building is designed to afford accommodations for about thirty students and from time to time has been occupied to practically its full capacity.

Students are accommodated with board and lodging at the dormitory at the rate of $20 a month, they being required to furnish only their own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself, and no student will be accommodated in this way to the exclusion of another student from dormitory privileges. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture. After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application. Dormitory privileges will be withdrawn from any student for boisterous and disorderly conduct in violation of the rules and regulations governing their action while in or about the building. The privilege of the dormitory is, therefore, for students of good behavior and who wish to study, without being interrupted.

Conduct of Students.

In the government of the School of Mines the largest liberty consistent with good work is allowed. Students are expected to conduct themselves as gentlemen upon all occasions and to show such respect for law, order, morality, personal honor, and the rights of others as is demanded of good citizenship. It is also hereby expressly stipulated that the use of intoxicating liquors, whether inside or outside the campus, and the frequenting of saloons and other places of questionable character are strictly prohibited. It is assumed that the act of registering as a student implies full acceptance of this policy. Failure on the part of any student to comply with this policy will be considered sufficient cause for removal from the institution.

EQUIPMENT.

Chemical Laboratories.

The chemical laboratories have recently been greatly enlarged and improved. As now arranged they occupy the entire south wing of the main building, while the store room, private laboratory, and chemical lecture room are located in the central section of the same building. Elements of chemistry and qualitative analysis are taught in the large laboratory on the main floor. The room, which is exceptionally well lighted and ventilated, is equipped with large hoods, a balance room, and twenty-four desks, each of which is supplied with gas, water, and electric light.

The basement laboratory has recently been remodeled and fitted with large windows, glass partitions, and modern desks. The east half of it is used for quantitative analysis and wet assaying. There are large hoods in each end which are supplied with hot plates and drying ovens, while each desk is equipped with an Alberine stone sink, water, gas, and electric light.

In the west half of the basement there are the instructor's laboratory, electro-chemical laboratory, and balance room. The latter is fully equipped with the best analytical balances supported upon a solid concrete table which is entirely free from vibration. The electro-chemical laboratory is supplied with current from a modern storage battery plant, consisting of a motor-generator, storage cells, and a switch-board so arranged that each student may obtain any current he desires for analytical or other electro chemical experiments. There is also a supply of alternating current from the city circuit which is used for light and small electric furnaces.

The laboratory is very completely equipped not only with all apparatus, chemicals, and supplies needed for the various courses, but the stock includes a large amount of pure chemicals and special apparatus, including standardized burettes, flasks, and weights which are used for the most accurate rock analysis and research work.

All apparatus is loaned to the students. Chemicals and supplies are furnished at cost.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types and large muffle coal and coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes, and other assaying materials and supplies.

A weighing-room containing a number of Becker's balances is conveniently located between the furnace-room and the lecture-room. In the grinding room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher and a Bolthoff sample-grinder and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers, and other necessary apparatus.

Physical Laboratory.

The physical laboratory occupies the east side of the north basement of the main building and contains the usual apparatus for illustrating the facts and laws of physics. In addition there has just been added at a considerable expense all the apparatus necessary to perform the quantitative experiments outlined in Course 2 of Department II.

Petrographical Laboratory.

For the microscopic study of rocks both in elementary and advanced or graduate work the School is well supplied with rocks in thin sections representing the various types of igneous, metamorphic, and sedimentary rocks accompanied by hand specimens, giving the student an opportunity to study the microscopic and megascopic characters of the rocks at the same time. The laboratory is well equipped with standard up-to-date microscopes with all accessories; also, a camera for microphotographic work with accessories for oblique and vertical illumination; also, a rock slicing machine with electric power attachment where the students in petrography are taught how to make and mount thin sections.

Mineralogical Laboratory.

For the study of minerals by physical characters and blow pipe test, the School is especially well provided with an abund-

ance of material of various ores and minerals for blow pipe determinations. Large collections for this purpose have recently been added to the School and the minerals are so arranged that no two students work with the same minerals the same day, thereby stimulating thorough systematic search for the elements and correct determination of the mineral specimens. The laboratory is well equipped with all necessary apparatus to carry on this work in an efficient and up-to-date manner.

Mineralogical Museum.

The Mineralogical Museum, with instructor's office, occupies the entire north wing of the first floor of the main building. The School owns a very fine collection of minerals and rocks of all kinds. These are arranged systematically, forming units for the various courses in Geology rather than for showy display. The minerals and rocks from the various mining districts are segregated, thereby giving the student the best possible opportunity of studying the ores and rocks of a district without having actually visited the field. The Museum is well supplied with such district collections throughout the United States, Mexico, and Canada. New specimens are being added most every day in the year.

Electrical Equipment.

The equipment of the new power plant consists of two semi-Diesel Fairbanks-Morse Company engines. The smaller of the two engines delivers about 15-horse power at full load, and is belted to an air compressor and also to a direct current dynamo. The compressor is used to store air in two cylindrical reservoirs at a pressure of 120 pounds per square inch for starting larger engine. The fuel oil used by these engines may be any crude heavy oil or distillate. The larger engine is controlled by an inertia governor on the main shaft and varies the supply of oil according to the speed. The cylinder is lubricated by forced feed. The larger of these two engines is intended to furnish most of the power on the campus. It is vertical and runs with very little vibration. The top of the cylinder is about eight feet above the base of the engine. The fly wheel is about seven feet in diameter and weighs nearly five tons. It is mounted between the vertical engine and the alternating current engine which will furnish

power to the engineering and metallurgical buildings. The alternating current generator gives a 3-phase current, so that either 3-phase current or single phase motors may be used in the various buildings. The larger engine and alternator will deliver 37.5 kilowatts at 125 volts when run at 1250 revolutions per minute. The current is about 47 ampheres per phase at ordinary full load. The field coils of the alternator are excited by means of a generator, which is run from the main shaft of the larger engine. The generator can deliver 40 amperes and 125 volts when run at 1250 revolutions per minute. The direct current dynamo connected with the smaller engine will deliver 60 amperes at 125 volts when run at 1250 revolutions per minute. The frequency of the alternating current at the ordinary speed of the larger engine is 60 cycles per second.

There are two switch boards, one for the alternating current power circuits and one for the direct current power circuits. The former was designed and constructed by the Westinghouse Electric Company, and the latter by the General Electric Company. The former contains three panels; an exciter panel, a generator panel, and a feeder panel. There are thirteen ammeters and volt-meters mounted on these panels, together with a three-phase watt meter. All switches are used in the main alternating current circuit and in the various feeding lines, which run to the 3-phase and single phase meters. It is possible to see at a glance the amount of current that is being used on these branches and the total amount of power that is being used on all the motors.

The voltage of each phase can also be measured. Current transformers are used in connection with the 3-phase wattmeter. There are the usual arrangements for ground detection. The switch board also provides for the connection of another similar power unit to run in sychronism with the present unit. This power plant is among the neatest and most complete in the West.

Mechanical Equipment.

The Board of Regents has authorized the purchase of the following equipment for the new engineering building, to-wit:

One wood-turning lathe, 12x36 inches, with outside face plates, floor stand and rest.

Two similar but smaller lathes, 12x24 inches.

One planer, 24x6 inches.

One joiner, 9 inches.

One band-saw, 30 inches.

One hand-trimmer, 15x5 inches.

One saw-table.

One improved oilstone grinder.

All of these machines are direct-connected with A. C. motors.

For the new draughting room there were ordered:

Twenty drawing tables, 33x60 inches, with drawers for instruments and materials.

Twenty stools with adjustable screw bottom.

One five-section filing cabinet, large size.

The new equipment will be delivered at the School in July and will be installed ready for the opening of school in September.

Metallurgical Equipment.

It is expected to install during the summer, crushers, stamp mill, jigs, rolls, concentrator, ball mill, and various other machines for carrying on experimental ore testing.

ENGINEERING INSTRUMENTS.

The Civil Engineering Department has all the instruments necessary for land, railroad, irrigation, mine, and topographic surveys. These include chains, tapes, range-poles, level rods, wye and dumping levels, complete transits, and plane tables. In purchasing instruments for this department only the best grade has been considered and the student has the opportunity to become familiar with the product of such well known manufacturers as Gurley & Sons, Eugene Dietzgen, Buff & Buff, etc.

The engineering department has recently purchased a new modern Gurley light mountain transit of the type, 27 A. The instrument has an auxiliary detachable telescope for use in mine shaft surveying.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the mechanical building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame or steel track, developing-vat, and drying rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. An Ingersoll-Rand drill and other pieces of machinery are used as models.

LIBRARIES.

The libraries of the New Mexico State School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats, and atlases, and volumes on history, travel, and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.
Mining and Scientific Press.
Engineering Record.
Power.
Engineering News.
Mining Science.
The Mining World.
Chemical and Metallurgical Journal.
Journal of the American Chemical Society.
Journal of Industrial and Engineering Chemistry.
Chemical Abstracts.
Geographic Magazine.
Economic Geology.
School of Mines Quarterly.
New Mexico Journal of Education.
All the U. S. Geological Survey Publications.
U. S. Bureau of Mines Publication.
Canadian Geological Survey Publications.
Various daily and weekly papers.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions and author's separates, pertaining to the respective divisions.

Powell Library.—The School has come into possession of the private library of the late Major John W. Powell of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology, philosophy and many rare monographs of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who has been so long identified with this western country, should find a permanent home in New Mexico.

SOCORRO MOUNTAIN MINES.

The silver mines at the base of Socorro Mountain, only about two miles west of the School campus, afford excellent opportunities for the practice of mine-surveying and for a study of some features of practical mining. The ore-bodies with associated geological structures and many other features will interest the student of mining and geological engineering.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each new student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is fifteen dollars a semester except to citizens of New Mexico, the tuition fee for the latter being five dollars a semester. This is payable at registration, and its payment

after matriculation admits the student to all class-room instruction. Students who hold scholarships pay no fee for tuition.

Laboratory Fee.

The laboratory fees are intended to cover the cost of gas, water and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Quantitative Analysis, Water and Fuel Analysis, Inorganic Preparations, Organic Chemistry, Electro-Analysis, Qualitative Analysis, Ore Analysis, each \$7.50; Fire Analysis, \$10.00; Mineralogy (Blowpipe Analysis), \$6.00; Metallurgical Laboratory, \$3.00; Shop, \$5.00; Mine Examination, \$1.00; Elementary Physics, \$3.00; Heat and Light, \$4.00; Experimental Mechanics, \$4.00; Electricity and Magnetism, \$4.00; Alternating Current, \$10.00.

A deposit of \$2.00 is required from each student who registers for any of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due from the breakage or damage to apparatus.

Graduation Fee.

The graduation fee, payable after delivery of diploma, is as follows:

Mining, Metallurgical, Geological, or Civil Engineer......\$10.00
Bachelor of Science.................................... 5.00

Board and Rooms.

Rooms may be obtained at a cost varying from \$6.00 to \$8.00 a month; board at the hotels and best boarding-houses for \$7.00 a week. The cost of living at the dormitory is \$20.00 a month.

Books and Other Supplies.

Books and other supplies for students are furnished through the office at publishers' prices with the freight or express charges added. A considerable saving is thus made in behalf of the student.

Summary of Annual Expenses.

A close approximation of a student's necessary annual expenses is tabulated below. By the practice of extreme economy a student may, of course, cut his expenses somewhat below the figures here given:

Board and room at dormitory	$180.00
Books and other supplies	60.00
Laboratory and other fees	25.00
Total	$265.00

SCHOLARSHIPS.

There are a few scholarships available each year in this institution which carry with them certain emoluments in cash and free tuition.

Instructors Scholarship.—Through the wisdom of the Board of Regents of the School of Mines there have been provided from two to five scholarships, discretionary to the president, carrying free tuition and from $150 to $200 per year. These scholarships are awarded only to worthy young men who have satisfactorily completed at least the college freshman work and who are otherwise worthy of recognition. The students carrying such scholarships shall be selected by the president, and they shall be required to give from one hour to not more than two hours each day instruction in the class room or in the field, shop, or in operating and having charge of machinery, etc., during the active school year, as they may be qualified in or are capable of doing.

School of Mines County-Scholarships.—Scholarships are open to one student from each county in New Mexico. These scholarships yield free tuition and are awarded by the president to indigent and worthy students.

Allis-Chalmers Scholarship.—To one member of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opportunity for four months' study and employment in any of its plants and an emolument of $150.00. This scholarship is awarded by the Board of Regents on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

SUMMER WORK.

The proximity of the School to mineral properties, mines, and smelters makes it easy for the student to secure employment during the summer and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining, have been attractive fields of work for the students during the vacation.

DEGREES.

The degrees of Bachelor of Science, Mining Engineer, Metallurgical Engineer, Geological Engineer, and Civil Engineer, are conferred by the Board of Regents upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of the institution, have completed the prescribed collegiate courses of any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed course of the four-year curriculum in Mining Engineering, has presented an original and satisfactory dissertation in the line of his work, and has done two years of professional work of which one has been in a position of responsibility. The degree is also conferred upon each one who, as a student of this

institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum, and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Metallurgical Engineer, Geological Engineer, and Civil Engineer, is offered upon terms similar to those required in the case of the Mining Engineer.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but in each case the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidence of independent investigation to warrant its publication in whole or in part.

CHEMICAL ANALYSIS, ASSAYING, AND ORE TESTING.

The wide demand which exists in the great mining districts of the Southwest for disinterested and scientific tests and practical investigations has led to the establishment by the New Mexico State School of Mines of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible and accurate results assured by reason of the exceptional facilities of the laboratories of the School and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special Act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be

collected and paid into the treasury of the School of Mines." By special resolution it is required that all charges shall be paid in advance. Prices for work will be sent on application.

FREE DETERMINATIONS.

For the benefit of prospectors and others, elementary blowpipe and physical tests will be made of any rocks, ores or other mineralogical material when sent to the School for their proper classification and determination. Such work in done to encourage prospecting and to more fully exploit the mineral resources of New Mexico, so little comprehended at the present time. For such work as indicated in this paragraph no charges will be made.

NEW SPECIAL APPROPRIATION.

During the legislative session of the present year, the legislature provided a special appropriation of $20,000 to be expended in new buildings, electrical, power, and metallurgical equipment for practical and demonstrative work in the methods of ore dressing, milling, etc.

Three new buildings are now about completed from this special appropriation and descriptions of which will be found elsewhere in the register.

Some of the new machinery and equipment have been ordered and more will be ordered soon. The whole of the installation will be made during the summer and ready for the opening of the fall term of school.

CALIFORNIA-PANAMA EXPOSITION

New Mexico was the first state to begin construction of its building at the San Diego Exposition. For a model the State Board of Exposition Managers took the historic church on the Rock of Acoma, adding to it a veranda and balustrade of the Franciscan Mission at Cochiti. This combination has provided a structure for New Mexico's exhibit that is the most striking of all exposition buildings, and one that is quite in harmony with the general architecture of the San Diego Exposition.

The location of the New Mexico building on the Exposition site at Balboa Park is on an eminence to the south and west of the main group of exhibit buildings, on the edge of a canyon, and with a commanding view of the ocean, bay, city and mountains. Its striking proportions are plainly seen by all visitors to the Exposition grounds, from the great viaduct which forms the approach from the west. It completes a picture that is absolutely beautiful and unique.

The New Mexico Board of Exposition Managers early decided that the most effective way of presenting the varied industries and natural resources of the state to those who visited San Diego in 1915 would be by carefully prepared lectures, supplemented with colored stereopticon views and moving picture scenario. Such lectures will be carried on during the whole time of the Exposition. Among the many interesting industrial features portrayed in moving pictures will be that of mining. The great mining enterprises, carried on by some of the largest operators in the world, in gold, copper, iron and coal, are certain to prove impressive sights in conveying to the mind something of the marvelous mineral wealth of the state. The output from the mines of New Mexico will reach approximately $20,000,000 in 1915.

In addition to the scenario illustrating the varied mining industries, there will be a comprehensive collection of the rare and economic minerals of the state displayed in exhibit hall in

the New Mexico building throughout the life of the Exposition. A publicity mining bureau will be established and every effort will be extended in supplying literature, maps, and like information to those interested in the geology, mineralogy and mining economics of the state.

President Fayette A. Jones of the School of Mines was appointed Mining Commissioner of the New Mexico Board of Exposition Managers and had direct charge of collecting and assembling the mineral and geological exhibit, which is said to be among the best ever assembled on the Pacific coast. All the exhibits installed in the New Mexico building are highly instructive and the building is a Mecca for the educators of the country.

It is thus seen that the New Mexico State School of Mines is officially connected with the San Diego Exposition and much good is expected to redound from this relation both to the School and in the further development of the mineral resources of the commonwealth.

It has recently been decided by the State Board of Exposition Managers to keep the New Mexico building at San Diego open during the greater part of 1916.

This will be good news to those who visited San Diego last season and who expect to again enjoy the educational treat offered them in the "Cathedral of the Desert." This second season will, also, afford an opportunity for those who did not find it convenient to visit the Exposition last year, but who expect to do so during the present season. Aside from the many other attractions, a visit to the New Mexico building alone is well worth the time and expense of a trip across the continent.

DIRECTORY OF GRADUATES AND STUDENTS

DIRECTORY OF GRADUATES AND STUDENTS†

ARTHUR H. ABERNATHY — Mapimi, Mexico.

Student, 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, Cananea, Sonora, Mexico, 1901; Assistant sampler, Cia. Minera de Penoles, Mapimi, Durango, Mexico, 1909-1910; Sampling foreman same company, 1910-1914; Special student at New Mexico School of Mines, 1914-1915; Sampling foreman Cia. Minera de Penoles, Mapimi, Durango, Mexico, 1915—.

ANTONIO ABEYTA — Pachuca, Mexico.

(B. S in Metallurgical Engineering, New Mexico School of Mines, 1914.)

Foreman at San Gertrudes Mine, Pachuca, Mexico, 1914—.

RAY COOK AHNEFELDT — Riverside, California.

Entered freshman class of Civil Engineering, 1913—.

EUGENE CARTER ANDERSON — Centreville, Mississippi.

(B. S. Miss. A. & M. College, 1913.)

Graduate student. Entered sophomore and junior classes of Mining and Civil Engineering, 1915—.

ALEXANDER ANDREAS, JR. — Laconia, New Hampshire.

Entered Freshman class 1915—.

GEORGE C. BAER — Mogollon, New Mexico.

(B. S. in Mining Engineering, New Mexico School of Mines, 1910.)

Student, 1907-1910. From Hillsdale, Michigan. Assayer, Tri-Bullion Company, Kelly, New Mexico, 1910; Millman, Socorro Mines Company, Mogollon, New Mexico, 1911; Mill foreman, same company, 1912; Engineer, same company, 1912—.

PETER A. BALLARD — Rapid City, South Dakota.

Entered Senior class 1915, candidate for degree of Mining Engineering.

JAMES HENRY BATCHELDER, JR. — Socorro, New Mexico.

(B. S., New Mexico School of Mines, 1909; E. M., 1910.)

Student, 1906-1910. From Exetor, New Hampshire. Mining, Chloride, New Mexico, 1911; Farming, San Acacio, New Mexico, 1911—.

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†Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

THOMAS HORTON BENTLEY Calgary, Alberta, Canada.
(B. S., New Mexico School of Mines, 1909; E. M., 1910.)
Student, 1907-1910. From Burro Mountains, New Mexico. Surveyor with Mildon & Russell, Nacozari, Sonora, Mexico, 1910; General engineering work, Hermosillo, Sonora, Mexico, 1911; Mining engineer, Portland, Oregon, 1911; Assistant superintendent, Norton Griffiths Steel Construction Company of London, England, with headquarters at Vancouver, British Columbia, Canada, 1912; Superintendent, same company, with headquarters at Calgary, Alberta, Canada, 1912—.

JAMES FIELDING BERRY Angangueo, Michiocan, Mexico.
Student, 1904-1905. From Socorro, New Mexico. Assayer, American Smelting & Refining Company, Aguascalientes, Mexico, 1905; Assayer, City of Mexico, Mexico, 1906-1907; Chemist, Cia Metalurgica y Refinadora del Pacificio, Fundicion, Sonora, Mexico, 1908; Assistant mine superintendent, American Smelting & Refining Company, Angangueo, Michiocan, Mexico, 1909-1914; Mine superintendent, San Gertrudis Company, Pachuca, Mexico, 1914—.

LOUIS AUGUST BERTRAND Upland, Nebraska
Student, 1895-1896. From Conway, Iowa. Student, Ecole Professionalla de l'East, Nancy, Lorraine. 1890-1894. Instructor in Mathematics and French, New Mexico School of Mines, 1895-1896; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and surveyor, Consolidated Kansas City Smelting & Refining Company, Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Mine superintendent, Cia. Minera de Penoles, Mapimi, Durango, Mexico, 1901-1903; Farming in Nebraska, 1903—.

HERBERT F. BISHOP Faywood, New Mexico.
Entered, Freshman class, 1914—.

ALEXANDER LOUIS BLACKBURN Austin, Texas.
Entered Sophomore class of Mining Engineering 1915—.

H. LAWRENCE BROWN Los Angeles, California.
Student, 1903-1905. From Chicago, Illinois. Positions: Assayer, Ernestine Mining Company, Mogollon, New Mexico; Engineer, Cia Concheno Beneficiador, Mexico; Mill superintendent, Milwaukee Gold Extraction Company, Phillipsburg, Montana; Engineer, Transvaal Copper Company, Sonora, Mexico; Manager, Morning Star Mining Company, Ophir, Colorado; Manager, San Carlos Mining Company, Sonora, Mexico; Manager of six properties and consulting engineer, Cobalt, Ontario, Canada; Superintendent, Haile Gold Mine, Kershaw, South Carolina; Exploration work in Venezuela, South America; Mill superintendent, National Mining Company, National, Nevada; at present, mining engineer with the American Metal Company with headquarters at Los Angeles, California.

PHILLIP A. CAMPREDON Metcalf, Arizona.

(B. S in Metallurgical Engineering, New Mexico School of Mines, 1914)

Assayer for Shannon Copper Company, Metcalf, Arizona, 1915—.

R. HARLAND CASE Deming, New Mexico.

Student, 1902-1905, from Cerrillos, New Mexico. Chemist, Compania Metalurgica de Torreon, Coahuila, Mexico, 1905-1906; Assistant superintendent, Bonanza Mines, Zacatecas, Mexico, 1906; Assistant manager, Stephenson-Bennett Mining and Milling Company, Organ, New Mexico, 1906-1907; Consulting engineer, Western Mining, Milling & Leasing Company, Colorado Springs, Colorado, 1907-1908; Mining engineer, Deming, New Mexico.

LEO CASEY Quemado, New Mexico.

Entered Academic Department, 1914—.

JOSE J. CHAVEZ Polvadera, New Mexico.

Entered Academic Department 1915—.

VIVIAN V. CLARK Seattle, Washington.

Student, 1896-1898, from Kelly, New Mexico. Assayer, Bland Mining Company, Bland, New Mexico, 1898-1899; Superintendent, Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine operator, Albuquerque, New Mexico, 1902; Manager Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903-1908; Consulting engineer, Consolidated Exploration Mines Company of New York, and allied syndicates, 1909-1910; President, Northern Engineering Company, Seattle, Washington, 1910-1912; President, Clark Mining Machinery Company, successors to Northern Engineering Company, Seattle, Washington, 1912—.

DAVID JOSHUE CLOYD Golconda, Arizona

Student, 1899-1900. From Decatur, Illinois. Chemist and assayer, Wardman's Assay Office, Aguascalienties, Mexico, 1900-1906; Assistant superintendent, Cia. Minera del Tiro General, and assistant superintendent, Cia. del Ferrocarril Central de Potosi, Charcas, San Luis Potosi, Mexico, 1906-1908; Assayer and chemist, Dailey, Wisner & Company, Torreon, Coahuila, Mexico, 1908; Chief assayer and chemist, Mazapil Copper Company, Saltillo plant, Saltillo, Coahuila, Mexico, 1911-13; Shift boss in the Concentrating Mill, Union Basin Mining Company, Golconda, Arizona, 1915—.

SAMUEL COCKERILL Indianapolis, Indiana.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-1906. From North Fork, Virginia. Post-graduate engineering course, Allis-Chalmers Company, 1907-1908; Wilwaukee Coke and Gas Company, Milwaukee, Wisconsin, 1908-1910; Citizens Gas Company, Indianapolis, Indiana, 1910—.

FREDERICK BROCK DAVY — Niagara Falls, New York.
Entered Freshman class 1915—.

HARRY H. DEVEREUX — Springfield, Illinois.
Entered Academic Department 1915—.

LEON DOMINION — New York, New York.
(B. A. Roberts College, Constantinople, 1896; C. I. M., Mining School University of Liege, 1900.)
Graduate student, 1903-1904. From Constantinople, Turkey. Assistant, United States Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-1904; Engineer, Victor Fuel & Iron Company, Denver, Colorado, 1904-1906; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-1907; Consulting engineer, Mexico City, Mexico, 1908-1909; Consulting engineer, New York City, 1910. Present address unknown.

LLOYD JESSE DRAKE — Albuquerque, New Mexico.
Entered Academic Department, 1913.

ETHAN J. EATON — Socorro, New Mexico.
Entered Academic Department 1916—.

ALEXANDER WALTER EDELEN — Mexico City, Mexico.
Student, 1905-1906. From Baltimore, Maryland. Assistant superintendent, Elkton Consolidated Mining & Milling Company, Elkton, Colorado, 1906-1907; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1907-1908; Superintendent, American Smelting & Refining Company, Angangueounit, Michiocan, Mexico, 1909—.

THADDEUS BELL EVERHEART — Socorro, New Mexico.
Student, 1905-1907. From Bells, Texas. Assayer and surveyor, Pereguina Mining and Milling Company, Guanajueto, Mexico, 1907-1908; Mill superintendent, Las Animas Mining and Milling Company, Pueblo Nuevo, Durango, Mexico, 1908-1910; Mining, Chloride, New Mexico, 1911-1913; Mining engineer, Socorro, New Mexico, 1914—.

THOMAS ALBERT FERGUSON — San Diego, California.
Entered Freshman class 1915—.

LEOPOLD E. FLEISSNER — Milwaukee, Wisconsin.
(B. S., E. M. in Mining Geology, New Mexico School of Mines, 1912.)
Student, 1910-1912. From Manistee, Michigan. Engineer, Sterling Engineering & Construction Company, Milwaukee, Wisconsin, 1912-1913; Engineer, Ray Consolidated Copper Company, Ray, Arizona, 1913—.

HOWARD M. GIBSON — Farmington, New Mexico.
Entered Academic Department, 1914.

HARRY THORWALD GOODJOHN Torreon, Coahuila, Mexico.
Student, 1902-1903. From Pittsburg, Texas. Assayer, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1903-1906; Chief chemist, Minera de Penoles Company, Mapimi, Durango, Mexico, 1906; Chemist and metallurgist, Cia. Minera, Fundidora, y Afinadora, Monterey, Mexico, 1907-1908; Chief chemist, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1909—.

SAMUEL JAMES GORMLEY West Jordan, Utah.
Student, 1895-1896. From Mt. Vernon, Iowa. Assistant professor of Engineering, New Mexico School of Mines, 1895-1896; Assistant assayer, Anaconda Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist, same company, 1900-1902; Superintendent of sampling works, Washoe Smelting Company, Anaconda, Montana, 1902-1906; Smelter superintendent, Bingham Copper & Gold Mining Company, West Jordan, Utah, 1906.

CHARLES GRAY Ontario, California.
Entered Freshman class, 1915—.

JOHN B. GUNTER Belen, New Mexico.
Entered, special student, 1914—.

DONALD EUGENE HAGEMAN San Diego, California.
Entered Freshman class, 1915—.

EDWIN CLARENCE HAMMEL Socorro, New Mexico.
Entered Academic Department, 1912—.

HENRY HAYS Estancia, New Mexico.
Entered Academic Department, 1914—.

EDMUND NORRIS HOBART El Paso, Texas.
(B. S., New Mexico School of Mines, 1910.)
Student, 1906-1908, 1909-1910. From Clifton, Arizona. Chemist, Socorro Mines Company, 1909; Chief sampleman, Shannan Copper Company, Clifton, Arizon, 1910-1911; Assistant surveyor, American Smelting & Refining Company. Angangueo, Michiocan, Mexico, 1911; Resident engineer, Capistante Mines Group, Mazapil Copper Company, Limited, Concepcion del Oro, Zacatecas, Mexico, 1912; Chief engineer, Charcas Unit, American Smelting & Refining Company, Charcas, San Luis Potosi, Mexico, 1913-1914; Mining engineer, Phelphs-Dodge Company, Morenci, Arizona, 1914; Mining engineer, El Paso, Texas, 1915—.

CARL JOHN HOMME Cooston, Oregon.
(A. B., St. Olaf College.)
Graduate student, 1899-1900. From Wittenburg, Wisconsin. Assayer and chemist, Candelaria Mining Company, El Paso, Texas, 1900-1901; Assistant superintendent, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902; Assayer, Glendale, Oregon, 1909-1913; Cooston, Oregon, 1914—.

WILLIAM ELIAS HOMME GLENDALE, Oregon.

(A. B., St. Olaf College.)

Graduate student, 1902-1903; From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. POWELL Santa Fe, New Mexico.

Student, 1900-1905. From Socorro, New Mexico. Civil engineer on railway from Acapulco, Mexico, 1906, 1907; Civil engineer, Mexican Central R. R., 1907-1912; Assistant to state engineer, Santa Fe, New Mexico, 1913—.

JOHN AUGUST HUNTER Denver, Colorado.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro, New Mexico. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-1904; Chemist and metallurgist, American Smelting & Refining Company, Aguascalientes, Mexico, 1904-1908; Metallurgist, Congress Mining Company, Congress, Arizona, 1909-1910; Assayer, Los Angeles, California, 1910-1911; Engineer, Pioneer Mining Company, Tucson, Arizona, 1911-1912; Engineer, American Zinc Ore Separator Company, Denver, Colorado, 1912-1914; Mining engineer, Socorro, New Mexico, 1914-1915; Engineer for Cananea Copper Company, 1916—.

SHOJI IRINO Gunmmaken, Japan.

Entered Junior class of Mining Engineering, 1916—.

FRANK A. JOHNSTON New Bloomfield, Pa.

Entered, 1911, from New Bloomfield, Pennsylvania. Secured B. S. degree in Civil Engineer, 1913.

PHILLIP R. JONES Hurley, New Mexico.

Entered Freshman class, 1914; Draughtsman for Chino Copper Company, 1915—.

LEON WILLIAM KELLY Montrose, Pennsylvania.

Entered Junior class of Mining Engineering, 1915—.

CHARLES THAYER LINCOLN New York, New York

(B. S., Massachusetts Institute of Technology, 1901.)

Graduate student, 1902-1903. From Boston, Massachusetts. Chemist, Bell Telephone Company, 1901-1902; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-1903; Acting professor, same, 1903-1904; Instructor in Chemistry, Iowa State University, Iowa City, Iowa, 1904-1905; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-1907; Chemist, Arbuckle Brothers Sugar Refinery, Brooklyn, New York, 1907-1909; Chemist, United States Custom Service, New York, 1910—.

FRANCIS CHURCH LINCOLN Reno, Nevada.

(B. S., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1903.)

Assayer, San Bernardino Mining Company, 1900; Chemist, Butterfly Terrible Gold Mining Company, 1900-1901; Professor of Metallurgy, New Mexico School of Mines, 1902-1904; Assistant superintendent, Ruby Gold & Copper Company, Ortiz, Senora, Mexico, 1904; General manager, Arizona Gold & Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907-1910; Mining engineer, New York, New York, 1911-1914; Head and professor of mining and metallurgy, MacKay School of Mines, University of Nevada.

RAFAEL LOPEZ Socorro, New Mexico.

Entered Academic Department, 1912—.

HORACE T. LYONS Globe, Arizona

(B. S. in Mining Engineering, New Mexico School of Mines, 1913.)

Mining engineer at Miami, Arizona, 1913-1914. Now at Globe, Arizona, in moving picture theatre.

N. L. MACDONALD Los Angeles, California.

Entered Freshman class 1914—.

HARRY C. MAGOON Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer, Illinois Steel Company, Chicago, Illinois, 1911.

FRANK MALOIT Tucson, Arizona.

(B. S. in Mining Engineering, New Mexico School of Mines, 1914)

Mining engineer at Lordsburg, 1914-1915; Assistant engineer of Xavier Mine for Empire Zinc Company, 1916—.

JOHN B. McDONALD Albuquerque, New Mexico.

Entered Academic Department, 1914—.

LAUCHLIN McLAURIN Fayette, Mississippi.

Entered Freshman class 1915—.

DANIEL M. MILLER Lake Valley, New Mexico.

(B. S., New Mexico School of Mines, 1909.)

Student, 1909. From Lake Valley, New Mexico.

TARVER MONTGOMERY Santa Ana, California.

Student, 1899-1900. From Santa Ana, California. County surveyor, Orange county, California, 1900-1901; Assistant engineer, Temescal Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles & Salt Lake Railroad Company, 1901-1902; Assistant engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

GENOVEVO MONTOYA

Entered, 1914, from Kelly, New Mexico. Academic Department.

WILLIAM ESTILL MOORE Lexington, Kentucky.

Entered Freshman class of Mining Engineering 1915—.

EARLE GIBBON MORGAN Guadalajara, Jalisco, Mexico.

(E. M., New Mexico School of Mines, 1911.)

Student, 1907-1908, 1910-1911. From Landsdowne, Pennsylvania. Pennsylvania State College, 1908-1910. Engineer, Socorro Mines Company, Mogollon, New Mexico, 1911-1912; Assistant engineer, same company, Guadalajara, Jalisco, Mexico, 1912—.

ERLE D. MORTON Gold Circle, Nevada.

(E. M. in Mining Geology, New Mexico School of Mines, 1909.)

Student, 1903-1905, 1908-1909. From Los Angeles, California Assistant superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-1906; Washington University, 1906-1907; Mine examiner, Los Angeles, California, 1907-1908; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908; Mine superintendent, Arizona & Nevada Copper Company, Luning, Nevada, 1909-1910; Mining engineer, Los Angeles, California, 1910; Chief engineer, Lone Mountain Tunnel Company, Superior, Montana, 1911-1912; with Braun Corporation, Los Angeles, California, 1912-1913; Assistant superintendent, Elko-Prince Mining, Gold Circle, Elko County, Nevada.

WILLIAM FREDERICK MURRAY Delagua, Colorado.

Student, 1904-1906. From Raton, New Mexico. In chief engineer's office, Victor Fuel Company, Denver, 1906-1907; Assistant engineer, Victor Fuel Company, 1907-1908; Assistant to chief and traveling engineer, Victor Fuel Company and Colorado & Southern Railway Company, 1908; Assistant engineer, Hastings Mine, Victor Fuel Company, Hastings, Colorado, 1909-1910; Superintendent, Cass Mine, Victor American Fuel Company, Delagua, Colorado, 1910-1913; Assistant general superintendent, Colorado Division, the Victor American Fuel Company, Trinidad, Colorado, 1913—.

HORATIO S. NOWAK Milwaukee, Wisconsin.

Entered Freshman class 1915—.

MARTIN J. O'BOYLE Mogollon, New Mexico.

(B. S. in Mining Engineering, New Mexico School of Mines, 1914.)

Mining engineer for the Socorro Mines Company, Mogollon, New Mexico, 1914—.

JOHN F. O'NEILL San Diego, California.

Entered Freshman class 1916—.

ORESTE PERAGALLO Tepec, Mexico.

(E. M., New Mexico School of Mines, 1908.)

Student, 1907-1908. From Ciudad Jaurez, Chihuahua, Mexico. Mining engineer, El Paso, Texas, 1908-1910; Graduate student, New Mexico School of Mines, 1910-1911; Mining engineer, El Paso, Texas, 1911-1912; Chemist, Tepec, Mexico, 1912-1914; Mining engineer, San Diego, California, 1915—.

DANIEL FRANCIS RECKHART El Paso, Texas.

Entered Freshman class, 1913—.

ALBERT BRONSON RICHMOND Tucson, Arizona.

Student, 1900-1901. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gabilan, Sonora, Mexico, 1901-1902; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and metallurgist, Patagonia, Arizona; General manager, Mansfield Mining & Smelting Company, Patagonia, Arizona, 1908; Consulting engineer, Tucson, Arizona, 1909; Field engineer, Mines Company of America with headquarters at Tucson, Arizona, 1910—.

DELL FRANK RIDDELL Parral, Chihuahua, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S, Nebraska State University, 1901; E. M., New Mexico School of Mines, 1905.)

Graduate student, 1903-1905. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, Sioux Falls, South Dakota, 1901-1903; Instructor in Chemistry, New Mexico School of Mines, 1903-1904; Acting professor of assaying, same, 1904-1905; Holder of Allis-Chalmers Scholarship, 1905-1906; Engineer, Universal Pump & Manufacturing Company, Kansas City, Missouri, 1906-1907; Superintendent, Benito Juarez Mine, Parral, Chihuahua, Mexico, 1907-1908; Consulting engineer and acting superintendent, Providentia Mines Company, Parral, Chihuahua, Mexico, 1908.

SOREN RINGLUND

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1910-1912. From Ceresco, Nebraska. Engineer, Empire Zinc Company, Kelly, New Mexico, 1912-1914; Mining geologist, New Jersey Zinc Company, 1915—.

ORLANDO DOUGLAS ROBBINS Depue, Illinois.

(B. S. and E. M., New Mexico School of Mines, 1909.)

Student, 1905-1909. From Louisville, Kentucky. Chemist, El Chino Copper Company, Santa Rita, New Mexico, 1909-1910; Mill superintendent, Germania Mining Company, Springdale, Washington, 1910; Chief campler, Inspiration Copper Company, Globe, Arizona, 1910; Engineer, United States Steel Company, Depue, Illinois, 1911-1913; Chief of ore and testing department of Mineral Point Zinc Company, Depue, Illinois, 1914—.

JULIUS SANCHEZ Socorro, New Mexico.
Entered Freshman class 1912—.

MANUEL A. SANCHEZ Mora, New Mexico.
Entered Sophomore class, Civil Engineering, 1914—.

CHARLES S. SHAMEL Seattle, Washington.
(B. S., M. S., University of Illinois; LL. B., University of Michigan; A. M., Ph. D., Columbia University.)
Graduate student, 1901-1902. Mining lawyer, Seattle, Washington.

JAMES AVERY SMITH Telluride, Colorado.
Entered, 1908, from Socorro, New Mexico. B. S. degree in Metallurgical Engineering, 1913; Assayer and sampler, Inspiration Copper Company, Miami, Arizona, 1913-1916; on oil flotation, Smuggler Union Mine, Telluride, Colorado, 1916—.

IRVING L. SMITH Socorro, New Mexico.
Entered Academic Department, 1913.

OLIVER RUSSELL SMITH Naches, Washington.
(B. S., Kansas College of Agriculture and Mechanic Arts, 1908; C. E., New Mexico School of Mines, 1902.)
Graduate student, 1898-1901. From Manhattan, Kansas. B. S. in Civil Engineering, New Mexico School of Mines, 1902; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1901; Instructor in Engineering and Drawing, same, 1901-1902; Assistant professor in Engineering and Drawing, same, 1902-1903; Assistant surveyor, U. S. General Land Office, 1902; City engineer, Socorro, New Mexico, 1902; Deputy mineral surveyor, U. S. General Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1903-1907; Civil engineer, Santa Fe Railway, San Bernardino, California, 1907-1908; Engineer United States Reclamation Service, Zillah, Washington, 1908-1910.

PAUL E. M. STEIN El Paso, Texas.
(B. S., New Mexico School of Mines, 1911; E. M. in Mining Geology, 1912.)
Student, 1907-1912. From Davenport, Iowa. Assistant engineer, Socorro Mines Company, Mogollon, New Mexico, 1912; Chemist, El Paso plant, Kansas City Consolidated Smelting and Mining Company, El Paso, Texas, 1912—.

EDWARD J. STEVENS Pinos Aaltos, New Mexico.
Entered Academic Department, 1914—.

KARL AKSEL STRAND Bisbee, Arizona.

(B. S. and E. M. in Mining Geology, New Mexico School of Mines, 1912.)

Student, 1906-1912. From Socorro, New Mexico. Ore classifier, Utah Copper Company, Garfield, Utah, 1912; Draughtsman, same, 1912-1913; Mine superintendent, New Jersey Zinc Company, Hanover, New Mexico, 1914—.

LEO RICHARD AUGUST SUPPAN St. Louis, Missouri.

(B. S. in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)

Student, 1895-1896. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-1897; Graduate student, Johns Hopkins University, Baltimore, Maryland, 1897; University of Warburg, Germany, 1898; Professor of Chemistry, Marine-Sims College, St. Louis, Missouri, 1898; Associate professor of Pharmaceutical Chemistry, St. Louis College of Pharmacy, 1913—.

OTTO JOSEPH TUSCHKA Monterey, Nuevo Leon, Mexico.

(E. M. in Metallurgical Engineering, New Mexico School of Mines, 1897.)

Student, 1893-1897. From Socorro, New Mexico. Assayer and chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-1898; Graduate student, New Mexico School of Mines, 1898-1899; Assistant sampling mill foreman and chemist, Guggenheim Smelting & Refining Company, Monterey and Aguascalientes, Mexico, 1899-1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chief chemist, Compania Minera, Fundidora, y Afinadora, "Monterey," Monterey, Nuevo Leon, Mexico, 1900—.

HOWARD LACY WALTON Ontario, California.

Entered Freshman class 1915.

LAURENCE P. WELD Thompson, Nevada.

(B. S. and E. M., New Mexico School of Mines, 1912.)

Student, 1908-1912. From Rochester, New York. Concentrator man, Original Amador Mines Company, Amador City, California, 1912-1913; Assistant engineer and chemist, same company, 1913; Smelter electrician, Mason Valley Mines Company, Thompson, Nevada, 1913—.

MILTON BENHAM WESCOTT Monterey, Nuevo Leon, Mexico.

Student, 1904-1905. From Chicago, Illinois. Engineering corps, Santa Fe Railway, 1905; Assistant county surveyor, El Paso county, Texas, 1906-1907; Assistant engineer Monterey Railway, Light and Power Company, Monterey, Nuevo Leon, Mexico, 1907; Assistant engineer, Monterey Water-works and Sewer Company, Monterey, Nuevo Leon, Mexico, 1907, 1908, Resident engineer, same, 1908—.

WAKELEY A. WILLIAMS Grand Forks, British Columbia, Canada.
Student, 1893-1894. From Council Bluffs, Iowa. Assistant superintendent, Granby Consolidated Mining, Smelting, and Power Company, Limited, Grand Forks, British Columbia, Canada, 1898. At present superintendent of same.

CHARLES FRANCIS WILLIAMS Mansfield, Ohio.
Entered, Freshman class, 1914—.

SAMUEL H. WILLISTON Chicago, Illinois.
Entered, Freshman class, 1914—.

INDEX

New Mexico State School of Mines

SOCORRO, N. M.

Certificate of Entrance Credits

English History										
Zoology										
Biology										
Botany										

Age .... years. Recitation period .... minutes. Number of subjects pursued each term or semester .... Laboratory period .... minutes.

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Superintendent or Principal.

Note—Place no figures in the column headed "Credits."

(OVER)

New Mexico State School of Mines
SOCORRO, N. M.

Certificate of Entrance Credits

THIS CERTIFIES THAT .... has graduated from the High School at ...., State of .... in the year 19...., and has completed the following subjects as indicated below:

Note—If the student has not graduated, cross out the words underscored above.

	Number weeks pursued	Hours per week	Standing	Credits		Number weeks pursued	Hours per week	Standing	Credits
Latin					Physiology				
Spanish					Geology				
German					El. Physics				
French					Chemistry				
Scandinavian					Am. Literature				
El. Algebra					Eng. Literature				
Adv. Algebra					Comp. and Rhetoric				
Pl. Geometry					El. Psychology				
Sol. Geometry					El. Economics				
Trigonometry					El. Pedagogy				
U. S. History					Phys. Geography				
General History					Civics				
Medieval History									
Modern History									
English History									
Zoology									
Biology									
Botany									

Age .... years. Recitation period .... minutes. Number of subjects pursued each term or semester ...... Laboratory period .... minutes.

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Note—Place no figures in the column headed "Credits."

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Superintendent or Principal.

(OVER)

NOT TO BE FILLED BY APPLICANT.

Certificate of

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Passed on by the Committee on Entrance and College Credits this .... day of ...., 191......

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Secretary of Committee.

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